ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVII. No. 26. NEW YORK, SATURDAY, DECEMBER 23, 1905. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . . . L. W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single copy, 10 cents. Back numbers, beyond one month, each 25

CONTENTS.

EDITORIAL:
Tellurium 963
Higher Voltages for Direct-Current Railway Operation 963
Power Transmission on a Magnificent Scale 964
The Elective System in Technical Education 965
Electrotherapeutics 965
The Electrical Nature of Matter and Radioactivity, by Harry C. Jones. 966
The Chicago Electrical Show 968
A New and Higher Standard of Direct-Current Operation, by Frank J. Sprague 968
Destructors and Their By-Products, by F. L. Watson 969
The Manchester Sections of the Institution of Electrical Engineers . . 972
A Novel Telephone Pay Station 972
Electricity from Garbage 972
Electric Plant of the City of Thun, Switzerland, by B. F. Hirschauer . . 973
The Surface-Contact System of Electric Railways in England 976
The Underwriters' Laboratories at Chicago, Ill 976
Chicago Street Railway Companies 977
American Institute of Electrical Engineers 978
The Turbine Steamer Carmania 979
The New York Electrical Show 980
Electrification of the Pennsylvania Railroad 983
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE 984
ELECTRICAL PATENTS 986
METHODS OF GETTING NEW BUSINESS 987
INDUSTRIAL SECTION:
Electrical Nurse Signal and Recorder 988
Westinghouse Charging Receptacle 988
Small Direct-Current Motors and Generators 989
The Advanced Work of the Hudson River Electric Power Company 990
Information for the Baltimore Electrical Directory 991
A New Pendant Quick-Break Switch 991
New Gasoline Motor-Car 992
The Meeting of the Massachusetts Street Railway Association 992
Independent Telephone Men of West Virginia 992
Changes in the Board of Directors of the Maryland Telephone and Telegraph Company 992
CURRENT ELECTRICAL NEWS 993

TELLURIUM.

In an interesting paper discussing the electrolytic refining of copper, which was read recently by Mr. Lawrence Addicks before the Franklin Institute, the author says that two of the rather troublesome impurities found in anode copper are selenium and tellurium. These two elements go into the slimes with the precious metals, and must be removed from them when recovering the latter. Mr. Addicks says that tellurium is an article almost without use in the arts, though small amounts are employed in medicine. The amount thus disposed of is, however, inconsiderable, since the output of a single refinery for one day will furnish enough tellurium to stock a large chemical supply house for a year. The material is therefore got rid of by burning it out, and is thus wasted. It seems a pity that a material which could be saved at little expense must thus be thrown away entirely. Tellurium, doubtless, has some properties which might be valuable, and it would seem worth while for the chemist to see if, in some way, it can not be put to use. The profits of copper refining lie in the by-products, and here is one that is almost entirely thrown away.

HIGHER VOLTAGES FOR DIRECT-CURRENT RAILWAY OPERATION.

In an interesting communication, which appears in another page of this issue, Mr. Frank J. Sprague comes out as an advocate for the use of higher voltages in the operation of direct-current railway systems. Mr. Sprague takes the stand that there is not sufficient reason why we should stop at 600 or 650 volts—the pressures commonly adopted to-day—and states that he is willing to undertake the installation of a direct-current system at a voltage of 1,500.

The need for an increase in voltage, which would thereby reduce the cost of the transmission line and diminish the number of substations required by a long railway system, has induced the electrical manufacturing companies to develop the alternating-current, single-phase motor. The designers of this machine have endeavored to retain the simplicity of the direct-current system, yet at the same time, by the means of higher voltage applied to the trolley lines, reduce the cost of copper and of substations. They have, however, because of the limitations of design, been forced to add a static transformer to the car equipment. Now Mr. Sprague says that he is confident that he can operate a direct-current system at such an increase in voltage as to obtain a large part of the advantages going therewith, without being handicapped by any of the disadvantages which still adhere to the alternating-current motor. For twenty years Mr. Sprague has been a firm believer of the simple direct-current series motor system. He still believes that it is the best yet devised, and now asserts that with certain desirable improvements, which are feasible, the system can be adapted to meet the requirements of long-distance lines.

Mr. Sprague in his letter does not indicate the method to be used in applying this higher voltage. It is conceivable that he might have in mind series operation of motor equipment. With a two-motor equipment used in this way, the advantages of series-parallel operation would be lost; but a road requiring such an increase in voltage would probably be of the interurban type, using possibly a four-motor equipment. In this case the series-parallel operation could be used effectively. The motors would then have to operate at about twenty per cent increase in voltage only. This arrangement would be advantageous, since the motors could be changed over into parallel operation for running through cities where it is probable considerable difficulty would be met in raising the voltage from that now used to the figure suggested.

Another solution of this problem of increasing the direct-current voltage was hinted at by Dr. R. B. Owens, of Montreal, Canada, at the recent meeting of the American Institute of Electrical Engineers. Dr. Owens said that he understood that the manufacturers of electrical apparatus are ready to furnish

rotary converters for 1,000, 1,500 or even 2,000 volts, and that this highest figure did not necessarily seem to be the limit. They are also prepared to construct railway motors for operating at these voltages, these being of the two-pole type, in which the frequency can be kept down and satisfactory commutation obtained. This, he said, was the answer of the direct-current system to the new alternating-current systems.

We are inured to startling announcements in the electric railway field, yet this new proposal will undoubtedly surprise many. It is evident that the direct-current motor still has staunch friends who are prepared to carry the fight to a finish. It seems strange that in an industry which has developed so rapidly as the electric railway that a voltage set in 1886 should remain the standard for twenty years.

POWER TRANSMISSION ON A MAGNIFICENT SCALE.

Frequent references have been made of late to the possibility of developing the Victoria falls on the Zambesi river, and applying the power thus obtained in the mines of the Rand. The power at present used in these mines is approximately 100,000 horse-power, while that which can be obtained at the falls is several times this amount. Moreover, the topography of the falls resembles somewhat that of Niagara falls. The river plunges over a steep cliff, where the crest is broken by a number of islands, falls into a deep gorge running nearly parallel with the face of the fall, and then is carried off as a swift torrent running between high cliffs. A suitable site for a power-house can be found or made near the foot of the fall, or located above the fall. Either of the two plans now employed at Niagara falls could be adopted without doubt of success.

The whole stumbling block, however, in this development lies in the fact that there is no probability—for a long time, at least—of establishing large consumers of power near the falls; but more unfortunate even than this is the distance of the falls from the point where it is proposed to transmit power. It will be remembered that, although the original intention at Niagara falls was to transmit the power over fairly long distances to industrial centres, the bulk of this power is at the present time utilized at the falls. That which is transmitted to a distance is comparatively small, but as the new plants go into operation it will, of course, increase considerably. At Victoria falls, on the other hand, practically all of the power would have to be transmitted some 700 miles—a distance of transmission far greater than any at present in existence.

To transmit power this distance, with commercial success, seems at the present time almost impossible. No voltage now employed commercially would be high enough to reduce the cost of the line to a figure which would not cripple the undertaking altogether. If, on the other hand, it is attempted to keep the cost of the line down by the use of high voltages, the engineers will have to go at once to a voltage so much higher than that which we have been able to use successfully to-day that the engineering difficulties would be very considerable; in fact, they would seem to be almost insurmountable in the present state of the art. No one expects the voltages now in use to remain the maximum commercially possible; but few can contemplate doubling or tripling our present voltages at one step without some doubts as to the possibility of doing so safely.

In a paper read before the American Institute of Electrical Engineers some time since, Mr. Ralph D. Mershon took up the question of the possible limit of long-distance transmission, and his general conclusion was that it would be feasible to transmit two or three hundred thousand kilowatts about 500 miles. This was held to be the limiting distance for the present outlook, and with a less power delivery the plan would hardly be feasible. Yet the plan discussed for Victoria falls contemplates transmitting power some 700 miles to a point where the total amount in use to-day is only 100,000 horse-power. Either higher voltages will be necessary than those suggested by Mr. Mershon, and they were far beyond present practice, or some plan of transmission other than the three-phase must be adopted.

Three-phase power transmission has been so successful in this country that no other system would be thought of. Yet there is another system apparently in successful operation in Europe. There are there two high-voltage, direct-current transmission lines, one operating at about 30,000 volts. How successful these systems have been we do not know, but they seem, at least, to have impressed the engineers who are considering the Victoria falls development, as they have recommended it. The advantages claimed for this system are that a higher voltage may be used, since this is determined by the strain upon the insulation. With a direct-current system the effective voltage would be equal to the maximum of the alternating-current system, the line of the direct-current system, consisting at most of but two conductors, will be simpler than the three-phase line; and it is easier to maintain a constant current at the generating station than a constant voltage at the point of distribution. Another advantage of this system is the simplification of the switchboard requirements; in fact, the switchboard is practically eliminated, leaving only one switch at each generator.

The disadvantages, however, are not inconsiderable. The plan calls for the operation in series of a large number of direct-current units, and there must be at the receiving point a similar arrangement of direct-current motors. This arrangement of apparatus we, in this country, have endeavored to get away from. It used to be common in the old days of arc lighting—at least at the generator—but the series motor running on such a system never obtained any substantial footing.

We will wait, with much interest, for further developments of this stupendous undertaking. There is no doubt that these great falls will be utilized some day, but the conditions at present do not seem to be altogether favorable. In an address delivered last summer before the British Association, Mr. Robert Hammond proposed erecting a large generating station near the mines of the Rand, and from this supplying the wants of these mines. This, it is estimated, could be done, and power sold for less than one and one-half cents per kilowatt-hour with a satisfactory profit. The Victoria falls plan would have to make a

better showing than this to offset the risk which would necessarily be involved in such an undertaking.

It is somewhat interesting to note the advocacy of a direct-current system for this great power transmission scheme by European engineers. Practically all American engineers would unite in recommending the three-phase system; but in railway work we have adhered tenaciously, until within the last year or so, to the direct-current system, while Europe has gone ahead with the three-phase.

THE ELECTIVE SYSTEM IN TECHNICAL EDUCATION.

It is a well-known fact that technical education, as at present given, is somewhat narrow and restricted. Not infrequently this is pointed out in public addresses, and the advantages of a broader training is emphasized. In a recent address delivered on founder's day at the Thomas S. Clarkson School of Technology, Mr. John C. Wait mentioned this condition, and suggested that the student just beginning his course should use some judgment, and not take up work for which he has no particular taste. Mr. Wait said that he was not advising that the lazy student be allowed to escape the drill of a mathematical course, but he thought that time devoted to work for which the student has no great liking was largely wasted.

No one knows better than the instructor in a technical course of the narrowness and limitations of his work. He knows the disadvantages, and he knows how his students are handicapped after graduation; but he has a problem to meet which it seems few not actually engaged in teaching appreciate. He takes a man from a high school, and in four years must give him a good foundation for an engineering profession; and it is required not only that the graduate shall have training, but he must also acquire some engineering knowledge. To do this, about three-fourths of the man's time is required for preparatory and general studies, and in the remaining fourth it is necessary to acquire as much training and knowledge as the average student can absorb. The preparation which is essential for this part of the student's work takes practically all of his time during his first and second years at college, about half of his time in the third year, and some time during his fourth year. Under such conditions no time seems available for studies not bearing directly on the man's work; in fact, a good deal of preliminary training which would be desirable is unavoidably omitted. Nevertheless, it is customary to require students in technical courses to take some non-technical subjects. This is done even at the expense of his principal subject. Courses as they are now laid down are compromises. Probably no instructor is entirely satisfied with the one which his institution offers.

To the plan of allowing the student to elect his work there are some serious objections. The principal one is the fact that the work of any one year is merely preliminary to the year following, and can not be omitted if the student is to go on with his course. Another objection, which is possibly less serious from the student's standpoint, but which would produce endless confusion in the work of the institution, is the inability of a student to say beforehand whether any particular course would be interesting to him or not. He can only judge from the opinions expressed by former students in that course, for it is unquestionably impractical to allow a man to sample a course for a week or two, and then change over. It is desirable that a student should enjoy his work, but it is evident that if he be allowed to dabble in many lines of instruction that he will gain a smattering of information scattered over various branches of knowledge, but he will not acquire that training of the mind so essential for any logical thought; and, moreover, his knowledge will be, in general, so superficial that it will be of but little value to him, and probably dangerous to those who may employ him.

It has been suggested by some conversant with the difficulties of offering an ideal technical course that at least six years be given to this work. Mr. Wait says that if the young man accepts his parents' support until he is twenty-four or twenty-six years of age that his ideal life will be shortened by a decade. The age of the graduate of a technical course is generally about twenty years. The work laid out for him in his course is usually sufficient to require eight hours of applied effort a day. Obviously, if he is to do justice to his studies he can not be expected to support himself at the same time. The courses now offered at technical schools are not ideal—that would be too much to expect; but they represent the experience of teachers, and of engineers as well, acquired during the past thirty years.

ELECTROTHERAPEUTICS.

An interesting address was delivered recently in London by Dr. H. Lewis Jones on "Some New Lines of Work in Electrotherapeutics." A brief abstract of the more important points brought out in this address appears on another page of this issue. Dr. Jones has employed electric current for introducing, by means of electrolytic action, drugs into the system. The method, it is said, is better than other methods now in use, as it carries the drug further and gives a better distribution. It has been used, with apparent success, for treating ulcers when other methods have failed. Dr. Jones has great hopes for this treatment, as it seems to accomplish what has hitherto been impossible.

One point brought out in the lecture is well worthy of repetition, yet it is one which to-day receives little attention from a large group of people. Dr. Jones said: "Electrotherapeutics could not thrive so long as it served mainly as a useful adjunct or accessory to other methods of treatment, but it has now made many forward strides and is becoming able to take a leading part in the treatment of many morbid states. If any method of treatment is to command the general attention of the medical profession, it must be able to render services which are superior to any which can be had from already tried and older methods; and, further, it should apply to conditions of disease in which relief is urgently needed."

In other words, an electrical treatment, to be acceptable, must, on account of the apparatus required, do more than simpler methods to justify itself; and the need at present is for methods of treating successfully diseases which have heretofore resisted all other means.

THE ELECTRICAL NATURE OF MATTER AND RADIOACTIVITY.

BY HARRY C. JONES.

CHAPTER XIII.—(*Concluded*).

THIS IS NOT A TRANSMUTATION OF THE ELEMENTS.

Since the discovery referred to above was made, there has been so much written about the "Transmutation of the elements having been effected," the "Dream of the alchemist realized," etc., that a paragraph on this subject seems highly desirable.

From some of the statements on this subject that have appeared, any one unfamiliar with the subject might conclude that we are now able to effect the reciprocal transformations of practically any elementary substances almost *ad libitum. We are no more able to effect such transformations to-day than they were a thousand years ago,* nor has such a transformation ever been effected by any man of science.

It appears to the writer to be one thing to discover an *unstable* system in nature, even if it corresponds to our definition of chemical element, which is *spontaneously* undergoing changes that are *largely unaffected even by the most extreme artificial conditions* that we can bring to bear upon it, and giving rise to another elementary substance as one of its decomposition products; and an entirely different thing to *effect the transformation* of a *stable element into another elementary substance by purely artificial means.*

By showing that helium is one of the decomposition products of radium, it has been shown that the process first described does actually take place, at least in the case of one substance. The second transformation still remains to be effected.

In calling attention to the above distinction, no attempt is made to belittle the magnificence of the discovery of the spontaneous formation of helium from radium, which, when we consider the difficulties involved in working with such small quantities of substances, is to be placed among the great achievements of modern science, and could not have been accomplished by a man of less experimental skill than that possessed by Sir William Ramsay.

The sole object is to warn the reader against any sensational and unscientific literature that may have been produced upon this very point, which is as harmful to the development of scientific thought, as it is detrimental to the dissemination of truth.

FURTHER EXPERIMENTS ON THE PRODUCTION OF HELIUM FROM RADIUM.

It is obvious that such an epoch-making discovery as that described above, would be subjected to the closest scrutiny, even when announced by such a distinguished authority as Ramsay. The first question that would occur to any one, is this, could the helium that appeared with the emanation have been *occluded* in the radium salt, and set free when the emanation was separated from the salt? This is, of course, a fair question to ask, but the answer was furnished by Ramsay himself. The salt of radium was heated in contact with a vacuum pump for a long time, so that any gas occluded in the radium salt must have been set free. When the salt of radium thus treated was allowed to stand until the emanation was formed, and this emanation then driven off and collected in a sparking tube, the presence of helium lines manifested themselves after a few days.

One fact, as has doubtless already been noted, in connection with the appearance of helium lines in the emanation of itself argues strongly against any helium having been occluded in the radium salt, and then set free when the salt was dissolved in water. The emanation freshly distilled from the radium salt, showed no trace of the helium spectrum. The spectrum of helium appeared only after the emanation had stood for some time. If the helium was really occluded in the radium salt, its spectrum should have manifested itself as soon as it was driven over into the Plücker tube. The fact that it did not, but appeared after the tube containing the emanation had stood for a time, is a strong argument in favor of the helium having been produced by some change taking place in the emanation itself.

An even more crucial test, if possible, of the occlusion theory to account for the helium was made by Curie, Dewar and Demarçay. Four hundred milligrammes of radium bromide were dried and placed in a small glass vessel. This was connected with a small Geisler tube, and the whole system exhausted. The degree of the exhaustion was registered on a monometer. During the three months that the bromide was contained in the exhausted glass vessel, gas was continually being given off. This gas was found spectroscopically to be hydrogen, produced probably by the decomposition of traces of moisture in the salt by the radium.

The radium bromide was now transferred to a small quartz vessel, which was then exhausted. It was heated until the bromide fused. The gases that were given off during the heating were passed through U-tubes plunged in liquid air. This condensed the emanation and any of the less volatile gases. During the heating some nitrogen gas was given off, having been occluded in the salt. The quartz vessel containing the radium bromide from which all occluded gases had now obviously been removed, was sealed up by means of an oxyhydrogen blowpipe.

After the tube had been closed twenty days, Deslandres studied its contents spectroscopically. The gas in the tube gave now the entire spectrum of helium.

The result of this investigation was to confirm in every respect the conclusion previously reached by Ramsay. Helium is formed as the result of some change going on in the radium, or in the emanation from the radium.

RELATION BETWEEN THE EMANATION AND HELIUM.

Having shown that the helium which appeared in the sparking tube along with the emanation, was not occluded in the salt of radium from which the emanation was obtained, the next question that was raised is, what relation does the helium bear to the emanation from which it is produced? It was easy to show in a number of ways that the emanation itself is not helium. The spectrum that first appeared when the emanation was collected in the sparking tube was not that of helium at all, but was an entirely new spectrum not corresponding to that of any known substance. As we have seen, the helium lines appeared only after the emanation had stood for a time. Again, the emanation is radioactive, giving off α particles. Helium does not give off such particles, and, indeed, is not radioactive at all.

Further, the emanation is condensed by passing through a tube surrounded by liquid air, while helium can not be condensed to a liquid even at the temperature of liquid hydrogen—helium being the one gas that has thus far not been converted into a liquid.

Helium is the lightest gas known next to hydrogen, its atomic weight being four, and the molecule monatomic. The emanation on the other hand has a molecular weight of about 100, as we have seen from diffusion experiments.

The emanation is, then, fundamentally different from helium in all of its properties, and yet helium is produced from it as is shown by spectrum analysis. A theory to account for the production of helium from the emanation should be mentioned,

even if it is insufficient, as it will be encountered in the literature.

It has been suggested that radium is not a chemical element, but a compound of helium with some, presumably unknown element. The helium that was produced from radium was the result of the breaking down of this compound. There are a number of reasons why this theory is insufficient. In the first place, radium has all the properties of a chemical element—including a well-defined spectrum. Again, such a theory would not account for the radioactivity of radium, nor for the amount of heat energy that is being liberated by it.

To explain the properties of this remarkable substance, a theory along entirely new lines, as we shall see, is necessary.

CHAPTER XIV.
Induced Radioactivity.

It was discovered by the Curies that substances in general, that were left for some time in the presence of radium salts, became radioactive. This was the case when the substances in question were protected from any dust of the radium salt. This phenomenon was named by the Curies "Induced radioactivity."

This property of rendering substances in the neighborhood radioactive is not limited to radium. Rutherford found that salts of thorium have the same property, and Debierne showed that actinium had the power of inducing radioactivity to a very high degree.

The Curies studied this property of radioactive substances in the following manner. They used a closed vessel into which the radioactive substance and the substances on which radioactivity was to be induced, were placed. Under these conditions, as would be expected, more marked effects were produced as well as more regular results obtained.

The active substance was placed in a small glass vessel open at the top, which was suspended in the centre of an inclosed space. Pieces of such widely different substances as glass, hard rubber, paraffin wax, aluminium, copper and lead, having, however, the same surface, were inclosed in the space along with the radium salt. It was found that *all* of these substances became radioactive, and were *radioactive to just exactly the same extent* when the free surfaces were the same.

To test whether the induced radioactivity was caused by the radiations falling directly upon the plate, a thick lead screen was placed in the inclosed space, to one side of the vessel containing the radium salt; and behind this screen was placed a piece of metal, having the same surface as the other objects in the inclosed space. It was found that this substance, thus protected from the radiations given out by the active salt, became just as radioactive as the other substances having the same surface, exposed to the direct action of the radiations.

The further interesting experiment was tried, of closing the vessel containing the radioactive substance. When the vessel was closed it was found that none of the substances became radioactive. By closing the vessel then, the power of the radioactive substance to induce radioactivity in other substances was lost. It was found that the induced activity was more intense and more regular if the active substance was in solution than if it was in the solid state.

Water itself becomes radioactive if allowed to stand in a closed vessel along with some salt of radium.

Certain substances, such as glass, paper, and especially zinc sulphide became fluorescent under the same conditions as those to which the above-named substances were subjected. When the induced radioactivity of these fluorescent substances is measured, it is found to be the same as the induced radioactivity of other non-fluorescent substances, subjected to the same exciting cause. The production of fluorescence in such substances, then, neither increases nor diminishes the excited radioactivity produced in them.

The Curies also established the following facts. If a given object is exposed to a radioactive substance in a closed vessel, the induced radioactivity in the object increases with the time of the exposure, until a certain definite maximum value is reached. This maximum value is independent of the nature of the gas that fills the vessel containing the active substance, and the substance in which radioactivity is to be induced; and is dependent, for a given arrangement of the apparatus, only upon the amount of the active substance present in solution in the confined space.

INDUCED RADIOACTIVITY PRODUCED BY THE EMANATION.

It has already been shown that the induced activity is not due to the radiations from the radioactive substances, since when the radiations are cut off from an object by a thick lead screen, this object still becomes radioactive if contained in a closed vessel with the radioactive substance. It has also been shown that if the vessel containing the radioactive substance is completely closed, the radioactive substance in the vessel does not excite radioactivity in objects around it.

This would strongly indicate that the excitent of radioactivity must be something analogous in properties to a gas, since it is so readily cut off, and since it can pass around a screen and induce radioactivity in an object placed behind the screen just as if the screen was not present.

The only substance given off from such radioactive bodies as thorium, actinium and radium, which has the properties of a gas, is the emanation; and we would expect that the induced or excited radioactivity was caused by the emanation.

This supposition was greatly strengthened by the fact that only those substances that produce an emanation, have the power of exciting radioactivity in non-radioactive substances.

This view that the induced radioactivity was caused by the emanation we owe to Rutherford, who furnished a number of lines of evidence for his theory. He showed that when the emanation from radium was cut off, the radium lost its power of inducing radioactivity in other substances. He also showed that the *induced radioactivity was proportional to the emanating power of the substance inducing it.* The amount of the emanation present was measured by its power to ionize a gas and thus render it a conductor. When this was compared at different intervals with the radioactivity produced, it was found that the two are proportional, to within the limits of experimental error.

INDUCED RADIOACTIVITY UNDERGOES DECAY.

We have seen that the radioactivity of the emanation itself undergoes decay. Since the emanation is the cause of the induced radioactivity, we would naturally expect that the induced radioactivity itself would decay with time, and such is the fact.

If a body is subjected for a considerable time to the emanation from thorium, and then removed, the excited radioactivity decays regularly, reaching half of its initial value, according to Rutherford, in about eleven hours. The rate of the decay of the induced radioactivity, like so many other properties of radioactive substances, is apparently independent of many of the conditions to which it is subjected. If the body rendered radioactive is subjected to the emanation from thorium for only a short time, and then

removed, a new phenomenon manifests itself. The induced activity, instead of beginning to decay as soon as the radioactive substance is removed, at first increases in intensity, and may *increase after a few hours to several times its initial intensity.* This increase is masked when the body has been exposed for a long time to the emanation, by the decay of the initial radioactivity, which more than compensates for it; and the result is an apparent decrease in the induced radioactivity from the beginning. The importance of this fact will appear later when we come to consider the theories that have been advanced to account for radioactivity and the accompanying phenomena.

The induced radioactivity produced by the emanation from radium decayed much more rapidly than that produced by the emanation from thorium. It undergoes changes somewhat analogous to those already considered, decaying to half-value in a few minutes.

We should naturally like to know whether this decay continues to the limit. Do the bodies once rendered radioactive by the emanation from naturally radioactive substances quickly become completely non-radioactive again? This information has been furnished, at least in part, by the Curies. They found that the induced activity produced by radium diminished to half-value in a few minutes, but a small, residual activity persisted for almost an indefinite time.

(To be continued.)

The Chicago Electrical Show.

Arrangements are being perfected for special features for the opening night of the Chicago, Ill., electrical show, which will run in the Coliseum from January 15 to January 27. It is announced that space has been contracted for by seventy-five of the largest electrical concerns in the country.

Manager Thomas R. Mercein states that the De Forest Wireless Telegraph Company will establish a temporary station in the Coliseum to demonstrate the practicability of wireless telegraph service, accepting commercial business from Chicago to Kansas City, St. Louis and New York city.

Various telephone companies throughout the country will make exhibits, the following companies having contracted for space: Swedish-American Telephone Company, Automatic Telephone Company, Chicago Telephone Company and American Telephone and Telegraph Company.

During the exhibition there will be three conventions at the Coliseum: the Northwestern Electrical Association, the Electrical Salesmen's Association and the Credit Men's Association of the Electrical Trades.

A New and Higher Standard of Direct-Current Operation.

To the Editor of the Electrical Review:

The hope of extended electric equipment and operation on the main lines of trunk railways, as distinguished from special problems such as terminals, tunnels and congested sections, lies not alone in the possibility of increased traffic or economy of operation, but in such limitation of capital investment as will keep the burden of interest account measurably below the savings effected.

A vital element in this investment is of course that relating to substations and conductors. As to the latter, it is evident that greatly increased potentials are necessary to keep down their size, or with any given cost of conductor per mile to increase the distance between substations, with resultant less aggregate investment in them and higher economy in operation. These are common requirements, no matter whether alternating or direct currents are used. The bearing of the increase of potential upon the problem is quite evident from a consideration of the following general facts: when the traffic increases directly as the mileage the distance between substations, with any given loss and size of working conductor, will increase directly as the increase of working potential; on the other hand, so long as the train load between substations is not increased, this distance will increase as the square of the potential; but taking the average of service conditions on a trunk line, the allowable increase in substation distance will lie between these extremes. To illustrate: doubling the working potential would probably on an average allow trebling the substation distances, and trebling the potential would very likely allow an increase to, say, five times in distance.

To meet the various economic requirements, and proceeding on the assumption that 500 to 600 volts is the limiting standard for direct-current operation, the principal energies of many engineers and manufacturing companies have of late been devoted to operation by alternating currents, with varying degrees of success, as applied to railroads, with the abandonment of third-rail construction and adoption of a special type of overhead contact. These developments have resulted in a variety of designs for both polyphase and single-phase motors, and considerable divergence in views as to potentials, frequency, and mode of construction and operation where the single-phase has been adopted.

It is not my purpose at present to enter into a discussion as to the comparative merits of the various systems, all of which have their field of usefulness. I have long advocated, and am keenly alive to the economic bearing of increased potentials, however obtained, but also mindful of certain practical features which must be considered in connection with them. I believe, however, that where alternating-current motor operation with overhead construction is adopted, there is little reason for halting at any moderate limit, but that such potential should be used as may be necessary, all things considered, to get a reasonably full measure of the possible economy of investment.

On the other hand, I have frequently pointed out that the limits of direct-current operation are by no means reached, and that five or six hundred volts was an arbitrary standard which present possibilities in construction of apparatus no longer warranted maintaining when leaving the field of tramways to take up the consideration of trunk-line applications.

The time has now come, I think, in view of the developments which are taking place on the terminals of the roads entering New York city, the interest which railway officials are taking in the subject, and especially because of the various claims which are from time to time made, when equipment engineers, in considering the practical application of electricity to the more serious problems of railway operation, shall have as a choice the possibilities of higher limits in direct-current as well as in alternating-current operation.

To that end I beg therefore to announce that if in any case, after considering the various kinds of equipment possible, it should seem from an analysis of all elements entering into the problem that a comparatively high-potential direct-current equipment would produce the best net results, I am prepared to engineer and carry to a successful conclusion a direct-current installation at a working pressure, even on a third rail, of not less than 1,500 volts, which is at least two and a half times that ordinarily used.

I believe that it may be admitted that, although oftentimes having taken a somewhat radical and advanced position in electric railway matters, I have never made a public proposal which I have not been ready when called upon to carry out, and should conditions arise warranting an equipment such as is proposed, I purpose to establish a new and necessary comparative standard in equipment possibilities. And I venture further to affirm that 1,500 volts is not the limit of practical direct-current operation.

Frank J. Sprague.

New York, December 14.

DESTRUCTORS AND THEIR BY-PRODUCTS.[1]

BY F. L. WATSON.

With regard to the construction of destructors themselves, the various designs differ principally in the methods of feeding, the methods of taking off the gases of combustion and the methods of applying forced draught to the furnaces. The simplest and most primitive method of feeding is the "front feed." In this system the furnace has only one door, into which the refuse is thrown by the shovel, and from which the clinker is withdrawn when necessary. This system is very suitable and convenient for small plants, where the cost of labor is of no great importance, and it has had a very considerable vogue, even for large plants, in cases where high steam raising results have been considered more important than cost of labor or other considerations. This system lends itself readily to the "spoon-feeding" of a furnace, which, in the case of coal-fired boilers as well as of destructors, is productive of a maximum rate of evaporation, but not necessarily of final economy. The "front-feed" system has the disadvantage that the unburnt refuse and the clinker have to be dealt with on the same floor, and there is always a risk of getting the two articles mixed up.

The "back-feed" system has been applied in many successful installations and has been adopted by various makers. It appears to me to possess every advantage which may be claimed for the "front-feed" system, and some additional advantages. In the "back-feed" system the refuse is stored in a convenient bin, which may, if desired, be enclosed to form a hopper, at the back of the cells away from the heat of the furnaces, and at a level which may be most conveniently arranged for easy charging. The refuse is thrown into the furnace by the back door, and the clinker is withdrawn from the front. The grate and drying hearth may be conveniently sloped so as to facilitate both the charging and clinkering operations. It will also be apparent that the height of cill convenient for throwing refuse in is not the same as the height most convenient for drawing clinker out. With "front-feed" cells a compromise has to be arrived at, but with "back-feed" cells the cills of charging doors and clinkering doors may each be fixed at the most convenient height above the respective floors.

The "top-feed" system is also one which has enjoyed and still enjoys a very large measure of popularity, and has been adopted with more or less success by, I think, all the different makers of destructors. In the most usual form of "top-feed" destructors a floor is provided on the top of the furnaces on which the refuse is tipped, and feed holes of various forms are arranged so that the refuse can be pushed or shoveled by hand into the furnace. "Top-feed" furnaces are frequently arranged "back-to-back," or in double rows, thus economizing space and keeping the whole plant more compact. The charging holes are sometimes closed by lids, and sometimes by packing the refuse into the feed holes, whose form is arranged to permit of this being done.

It will be observed that in all these methods of feeding, a provision is made for the storage of a certain quantity of refuse, and this is always necessary because a destructor must work with strict regularity if it is to be successful, and the collection and cartage of refuse is usually arranged to be done in the shortest number of hours per day, and can not very well be changed about to suit the requirements of the destructor.

It would solve a great many difficulties if ordinary town refuse could be stored in a large hopper tapering toward the bottom, and having a door out of which it could flow when required, exactly as is done in the case of the storage of coal for gasworks and boiler purposes. Unfortunately, even with the best of arrangements, a piece of matting or oilcloth, or a large can coming through with the refuse is sufficient to cause a block and stop the whole business, and we must, therefore, reckon with the ascertained fact that refuse will not flow as a dry material will. It is, undoubtedly, a great advantage to get rid of handcharging altogether, and this has been done with some success in several plants. I have a diagram of one method which has been adopted at Westminster and at Blackpool, and with some modification at Bromley. In this arrangement the refuse carts tip their load bodily into the furnace on arrival at the destructor. A door is provided large enough to permit this, and is sealed by dipping into water all round its edges when closed. When the door is opened a movable hopper fits into the opening so that the refuse does not fall into the water trough. The arrangement works very well, and is remarkably clean and wholesome for the workmen. The one difficulty it presents is that of storage, and in the instances mentioned this difficulty is got over by providing sufficient spare carts to stand full at the destructor until required.

For larger plants another system of storing has been devised, which is being installed on a small scale for the Leeds corporation, and is also under construction in St. Petersburg, and will shortly be employed at Newcastle. In this arrangement the place of the spare carts is taken by a series of storage tubs having self-opening bottom doors, which are held closed by means of lifting chains. Into these tubs the carts tip their loads on arrival at the destructor. The tubs are lifted by an overhead traveling crane and stacked full until required. Each tub holds a full charge for a furnace, and in charging, the tub is lifted by the crane and placed on the top of a movable hopper, which is caused to descend by the weight of the tub. The water-sealed door is connected to the hopper by an arrangement of rods and levers, and is thus automatically opened by the descent of the tub, and in the same way automatically closed when the tub, after being emptied, is lifted clear by the crane. It is too early yet to say much of the results which will attend this method of charging destructors, but it has been considered to promise sufficiently well to justify its construction under guarantees. It will, in large plants, effect a considerable saving in labor, and this will be sufficient to justify the capital expense of the additional machinery involved; it is not, however, suitable for small plants. For capacities up to sixty or eighty tons per day I do not think anything will be found superior to the ordinary "back-feed," or the ordinary "top-feed," or the Bromley "cart-feed" system, either of which may be adopted according to circumstances.

As regards the taking-off of the gases of combustion, there are, speaking broadly, three methods in use.

The first and most primitive is the drawing off of the gases at the back of the furnaces. This answers quite well with "front-feed" cells, but if adopted with cells which are fed from the back it results in unburnt gases and smoke passing away to the flue.

The next method to be considered is that by which the gases from one cell or "division" of the destructor (for in this system the destructor can hardly be said to have any cells) are carried into the next division, and so on to the end of the battery. The last section of the battery has thus to carry through the whole

[1] Abstract of a paper read before the Leeds local section of the Institution of Electrical Engineers, November 28, *Electrician*, London.

of the gases from the plant, which makes it pretty warm for the stoker at that end. Furthermore, there does not appear to me to be quite the same certainty of perfect combustion in the last section as there is with cellular systems, and it is not possible to repair any one section without stopping the whole plant. For these reasons I should not advocate this system except for small plants, and if adopted for large plants I should consider it necessary to divide them up into small batteries.

The next system is that in which the outlet flues are situated toward the front of the furnaces and are connected by cross flues with a common combustion chamber, in which all the gases mix before passing to the boilers. This system, which was originally invented by Mr. William Horsfall, of Leeds, has been adopted very largely, and is now used by several of the best known makers. The system ensures a perfect mixture of gases at all times, and enables each cell to be repaired independently. The course of the gases from the grate to the boilers is a trifle longer with this arrangement than with that in which they pass from one section to the next and so on, but this is, in my opinion, more than counterbalanced by the other advantages of the system.

To come now to the different methods of applying forced draught. Steam jet blowers are frequently accused of being very wasteful in steam, but as they have been tested down to ten per cent of the steam raised, I do not think that fan-draught can show a much more economical result than that. For refuse containing large quantities of carbon, the injection of steam with the air has an advantage in the production of water-gas in the lower part of the fire, and the carrying of the combustion to a point further on in the furnace, and the production of a longer flame; it also assists in preserving the grate bars. Fan-draught, on the other hand, seems specially suitable for refuse which is chiefly of a vegetable character, and when suitable fans or blowers are used, it is possible to get a very much higher blast pressure than is practicable with steam jets. If a system of feeding be adopted which will enable very large quantities of refuse to be charged into the cell practically instantaneously there is going to be a great advantage from an increased rate of combustion; and in such plants I have no doubt that fans will be the most successful. For smaller plants I consider that steam jets, if well designed and properly made, will hold the field for a long time to come.

There is a considerable advantage from heating the blast for destructors, and this has been done in various ways. In some cases an air-heater, consisting of a stack of pipes fixed in the flue at the back of the boilers, is used, through which the air for combustion is drawn by the blower or fan. The rise of temperature obtained by this means, though undoubtedly valuable, can not be very great unless there is a big waste of heat from the boilers.

Another system is to deliver the air through cast-iron side boxes, fixed in the furnace sides, which boxes are kept hot by their contact with the clinker and burning refuse, and at the same time these boxes give a protection to the brickwork of the cell against destruction by clinker. An ash-pit temperature of 400 degrees Fahrenheit to 600 degrees Fahrenheit can thus be obtained, which must very materially assist combustion.

In furnace details great improvements have been made, and it should particularly be mentioned that all doors should fit tightly on planed faces to prevent the escape of gases or the inrush of cold air, and modern high-temperature destructors require to be very strongly stayed. The furnace linings must also be constructed of the best firebricks, or their life will be short. It must be remembered that in a good destructor, properly worked with forced draught, the connecting flues and combustion chamber, as well as the inside of the furnaces, will be maintained at a constant bright-red or nearly white heat, and it should be the aim of a destructor foreman to see that the heat is never permitted to drop while the plant is at work.

It is very largely a question of perfectly regular stoking, and of the proper adjustment of the chimney-pull and the forced draught. Too strong a chimney-pull will at once reduce the temperature, and the aim should be to work with the least possible draw over the fire, practically a plenum in the furnace itself. It will also reduce to a minimum the amount of dust carried out of the furnace, which is most marked when a very strong chimney draught is used. As close as possible to the furnace combustion chamber should be fixed the boiler or boilers which are to utilize the available heat. For every 10,000 inhabitants, there is, roughly, ten tons of refuse per twenty-four hours, and this is capable of producing over fifty horse-power if properly utilized. Therefore, the boilers are a most important item, and they should be properly proportioned to the plant. They may be of any of the well-known types, but the "water-tube" boiler is generally the most convenient, and I think the most efficient.

After the boiler, in all but the smallest of plants, a dust-catcher should be fixed. The most widely known form of dust-catcher is on the centrifugal principle, the heavier particles of dust being separated from the gases by centrifugal force while the gases are passing rapidly around the interior of a circular annular chamber. The dust is collected in external pockets attached to the chamber. It has been found that such a dust-catcher is capable of arresting over ninety-eight per cent of the total dust contained in flue gases. The material collected in the dust-catcher is extremely fine, sharp and clean, and is used for various purposes, one of the most important being as a base for disinfecting powder. From the dust-catcher the gases pass to the chimney, and this need not in most cases be of any great height. The old-fashioned high chimneys were only necessary for old-fashioned, low-temperature destructors. With a modern destructor, unless the situation is very exceptional, a chimney from sixty feet to ninety feet in height is all that is necessary.

One could almost fill another paper with descriptions of the various machinery for the manufacture of mortar, crushing and screening of clinker, the convenient removal of clinker from the front of the furnaces, and the manufacture of clinker bricks and of concrete flags, etc. All these machines have been made the subject of deep study, and may be obtained specially adapted to destructor work.

With regard to the buildings surrounding the plant, these should, as far as financial considerations will permit, be ample in size, lofty, well ventilated, and lighted from the top, and the openings for wheeling out clinker, etc., should be provided with doors, in order to prevent the draughts, which are frequently troublesome in destructor houses, causing dust to blow about and get into people's eyes and throats.

Generally, it may be said that when all proper precautions have been taken in the construction and working of the plant a destructor is a source of no nuisance whatever, and the only inconvenience of which the neighbors could possibly complain is that due to the carting of the refuse through the streets. Even that can be reduced to a minimum by the use of proper carts and by proper attention to cleanliness. In numerous instances dwelling houses have been built in large numbers close to an existing destructor after the

latter has been at work, and I remember one instance in which the owners of some property near a proposed destructor, after attending at the local government board enquiry and raising all the opposition of which they were capable, proceeded as soon as the plant had been erected to acquire more land and construct more houses much closer to the plant than those which they originally possessed.

As examples of good practical results in the way of steam raising and electrical production, I insert here particulars of the official twelve hours' test of the Batley destructor in May of this year, and an abstract of the report presented to the corporation of Bradford by Mr. W. M. Binny on a trial carried out by him at the Sunbridge-road destructor in that city. It will be observed that the latter trial was run over seven days and nights continuously. The steam-raising results agree reasonably with those which have been got in other instances, bearing in mind that the refuse of different towns is by no means equal in calorific value. The total electrical output for the week being 50,638 units, and the refuse burnt being nearly 833 tons, the output per ton was sixty units, which is pretty good for a continuous result, seeing that all steam used by jets and feed pumps, and blown off through the safety valve, was also raised by the destructor itself. At Batley a superheater is installed, so that the steam is delivered to the engine over fifty yards away at a considerable superheat.

TEST REPORT ON BATLEY DESTRUCTOR.

Date of test, May 18, 1905.

Duration of test, twelve hours.

Number and type of cells, three cells, "back-feed" type.

Total grate surface, ninety superficial feet.

System of forced draught, Horsfall patent steam-jet hot-blast.

Nature of refuse, trade, household and night soil.

Number, size and type of boilers, one Lancashire boiler, eight feet by thirty feet.

Economizer, number of tubes, "Green's," seventy-two tubes.

Total quantity of refuse burned, sixteen tons ten hundredweight.

Total quantity of refuse burned per square foot of grate per hour, one hundredweight five pounds.

Tons per man per shift, five and one-half.

Total water evaporated, 4,880 gallons.

Total water per hour, 406.6 gallons.

Total water per pound of refuse from and at 212 degrees Fahrenheit or 100 degrees centigrade, 1.60 pounds.

Percentage of clinker and ash to refuse burned, thirty-three per cent.

Main steam pressure, 175.4 pounds.

Mean feed temperature, 56.7 degrees Fahrenheit.

Mean main flue temperature, 2,000 degrees Fahrenheit.

Mean temperature behind boilers, 675 degrees Fahrenheit.

Horse-power developed at twenty pounds steam per indicated horse-power per hour, 203.3.

Purpose for which steam is utilized, generating electric current, central station adjoining.

NO. 1 TEST—OF THE WHOLE OF THE DESTRUCTOR AND ELECTRICITY PLANT TOGETHER.

Date of test, from noon, March 15, 1905, to noon, March 22, inclusive.

Duration of test, 168 hours.

Number and type of cells, twelve cells, single-row, top-fed.

Total grate surface, 360 square feet.

System of forced draught, hot-blast, with steam jet blowers.

Average air pressure under grates, one inch, water.

Average steam pressure on blowers, fifty-four pounds per square inch.

Nature of refuse, ash-pit, market and paper.

Total quantity of refuse burned, 283 tons sixteen hundredweights three quarters.

Total quantity of refuse burned per cell per twenty-four hours, nine tons eighteen hundredweights one quarter.

Tons per man per shift, 6.6 tons.

Total of clinker and ash from refuse burned during test, 421 tons.

Note—Ashes were weighed wet as cooled.

Number of firemen and chargers, eighteen.

Wages per day, four shillings tenpence.

Number of boilers and type, two marine type, Babcock & Wilcox water tube.

Size of boilers, 2,393 square feet heating surface in each.

Mean steam pressure on boilers, 146.5 pounds per square inch.

Total steam generated in boilers, 2,191,000 pounds.

Total steam generated in boilers per hour, 13,042 pounds.

Total steam generated per square foot of heating surface per hour, 2.72 pounds.

Total steam generated per pound of refuse from and at 212 degrees Fahrenheit, 1.25 pounds.

Mean feed temperature, 195.6 degrees Fahrenheit.

Mean main flue temperature, 1,880 degrees Fahrenheit.

Mean temperature of flues leaving boilers, 496 degrees Fahrenheit.

Economizer, 160 tubes.

NO. 2 TEST—STEAM USED BY JETS FOR FORCED DRAUGHT (INCLUDING FEED PUMP, ECONOMIZER, ENGINE AND LEAKAGE). THE ELECTRIC LIGHT ENGINE WAS STOPPED AND DISCONNECTED.

Date of test, March 22, 1905.

Duration of test, six hours.

Total evaporation by boilers in six hours, 13,698 pounds.

Number of boilers in use, one.

Note—No. 2 boiler was shut off entirely.

Water evaporated per hour, 2,283 pounds.

NO. 3 TEST—STEAM USED FOR FEED PUMPS, ECONOMIZER ENGINE AND LEAKAGE. THE STEAM JETS AND ELECTRIC LIGHT ENGINE SHUT OFF AND DISCONNECTED.

Date of test, March 22, 1905.

Duration of test, two and one-quarter hours.

Total evaporation of steam by boiler for two and one-quarter hours, 2,258 pounds.

Water evaporated per hour, 1,003.6 pounds.

During test No. 2 the destructor cells were kept working at the same capacity as during No. 1 test, thereby deducting steam used per hour in test No. 3, when the steam jets were shut off, from steam used per hour in test No. 2. The difference, namely, 1,280 pounds of steam per hour is the amount approximately required to work the jets for forced draught when the cells are working at their guaranteed capacity.

NO. 4 TEST—ELECTRICAL OUTPUT OF THE STEAM ENGINE AND DYNAMO.

Date of test, from noon, March 15, 1905, to noon, March 22, 1905, inclusive.

Duration of test, 168 hours.

Readings of dynamometer at beginning of test, 54,840.

Ditto at end of test, 105,478.

Difference, 50,638.

Mean voltage, 516.7.

Mean steam pressure in steam chest, 130 pounds per square inch.

The above output might be increased if it could be arranged for the engine and dynamo to utilize the steam that blows off at the relief valve.

SUMMARY OF TESTS.

From the above tests it is possible to ascertain if the conditions were carried out by the contractors. With regard to the first condition, the tests show that the

average consumption of refuse was slightly less than the guaranteed consumption, but this may be attributed to poor results obtained on the first day of the test, when the stokers were probably inexperienced in getting the best results, and if the test had been continued for another twenty-four hours, so as to eliminate the first twenty-four hours, the result would have been quite up to, or over the guarantee; and this is borne out by the steady improvement during the progress of the test.

With regard to the second condition, the test shows that the boilers can generate twenty-five per cent more steam than they are guaranteed for.

With regard to the third condition, the test shows that the boilers were able to raise and provide steam at the rate of 13,042 pounds per hour instead of the guarantee rate of 11,200 pounds per hour. The average steam pressure was 146.5 pounds per square inch, while the guarantee was for 145.

With regard to the fourth condition, the test shows that the steam required for the purpose of creating the necessary draught amounted approximately to 1,279.4 pounds weight per hour, while the guarantee was for 1,200 pounds weight per hour.

This result can only be taken approximately, as it was very difficult with the plant arranged as it is to make this test, on account of allowances having to be made for steam used by feed pumps, economizer engine and leakages of steam, and I do not attach much importance to the excess amount, as so very much more steam was generated than was possible to be used in the electric-light engine, and a great deal of surplus steam was continually blowing off to waste through the special escape valve I had provided for it.

These reports lead me to a matter of great importance to electrical engineers—the allocation of costs and returns as between the destructor and the electricity works, and the management of the joint undertaking. If the cleansing department runs the destructor and sells steam to the electricity department, it will be run for sanitary purposes, and may not give its maximum results when the electricity department wants them; if by the electricity department, it may be run for steam regardless of sanitary considerations. Again, if the sanitary department is to be paid for steam, how is the quantity to be ascertained? I know of no satisfactory method, since the quantity used in the destructor itself is generally more or less uncertain. The value of the steam per ton is easily ascertained from the cost of raising the same quantity by means of coal. The ideal method would appear to be to drive an independent generating set from the destructor, and to work this set as nearly as possible at a constant load, crediting the destructor with the actual output. If the generating set can also be retained in the control of the cleansing department, and the current delivered by meter to the electricity department, it is better still.

The Manchester Sections of the Institution of Electrical Engineers.

The Manchester section of the British Institution of Electrical Engineers has arranged a very interesting series of papers for discussion during the season of 1905-1906. Meetings will be held in the physical laboratory of the University of Manchester at 7.30 P. M., as follows:

January 16, 1906, W. C. Mountain, "Electric Winding as Applied to Main Shafts, Consider Practically and Commercially."

January 30, James Atkinson, "Gas Engines Applied to Electric Driving."

February 13, M. B. Field, "Idle Currents."

February 27, T. H. Schoepf, "Single-Phase Railway Working."

March 2, annual dinner.

March 13, J. R. Salter, "Economic Considerations in the Employment of Storage Batteries."

March 27, L. J. Hunt, "Alternating-Current Motors."

April 10, general meeting; H. C. Crews, "Lifts and Hoists."

The Manchester students' section of the Institution of Electrical Engineers has also arranged a series of papers as follows, the meetings being held at 7.30 P. M. at the Municipal School of Technology, Manchester, and the Royal Technical Institute, Salford:

December 22, J. C. Ward, "The Electrical Equipment of Automobiles."

January 12, 1906, W. T. Massey, "The Manufacture of Electric Cables."

January 26, F. Shaw, "Electric Lamps."

February 9, H. A. Carney, "Electrical Instruments."

February 23, annual dinner.

March 9, E. Müller and J. Davies, "Modern Primary Batteries."

March 23, R. C. C. Yates, "Lubrication and Lubricants."

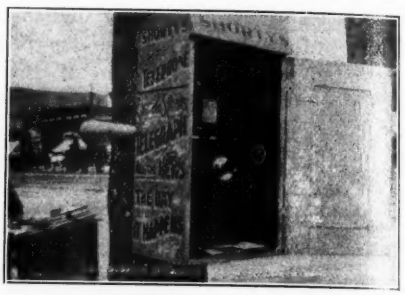
March 23, W. Browning, "Notes on Electrical Conductivity."

April 6, general meeting; D. L. Sands, "The Selenium Photometer."

A Novel Telephone Pay Station.

A public telephone pay station of unusual interest was in regular operation last summer at Colorado Springs, on Pike's Peak avenue, at the corner of North Tejon street. The instrument is connected with the common battery system of the Colorado Telephone Company, and is mounted in a substantial wooden box on a pole at a convenient height for passers-by. The box is supplied with the usual telephone directory, and the instrument is equipped with the familiar slot and cash-box used in "nickel service."

The interesting feature of the installation is the small megaphone trumpet shown in the illustration, twelve inches long and four inches in diameter and constructed of tin. The telephone station primarily constitutes the local substation of a newsstand about twenty feet away, and the object of the megaphone is to enable the newsman to hear the ringing of the telephone bell amid the noises of the street—a matter of no small difficulty otherwise when the box door happens to be closed.



A Novel Telephone Pay Station.

Electricity from Garbage.

Consul-General Guenther, of Frankfort, Germany, in a recent consular report describes an incinerator plant recently erected at Zurich, Switzerland, for the disposal of the city's garbage. The plant is located in the outskirts, and contains twelve furnaces capable of burning 120 metric tons of refuse in twenty-four hours. The loaded wagons are lifted by means of an electric derrick upon a platform above the furnace, into which the material is dumped. As the refuse does not burn easily, an electric blower injects a strong current of air which has been heated by passing through flues in the furnace walls. The heat engendered by the burning of the garbage is sufficient to make steam in two large boilers of eight atmospheres super-pressure. The steam is used in the usual way to operate a dynamo. The electric power produced is employed for the purpose of the plant and to supply part of the power for the electric railroads of the city. From thirty to forty per cent of the original refuse remains in the form of slag. This slag, by mixing with lime, is used for making bricks and paving blocks. The plant is said to be a paying institution.

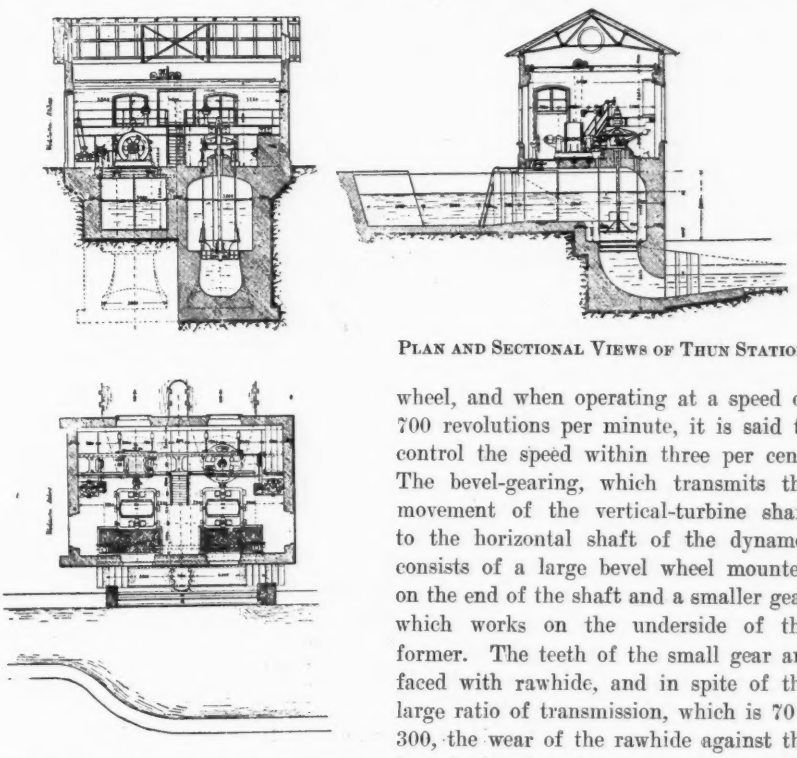
Electric Plant of the City of Thun, Switzerland.

By B. F. Hirschauer.

THE city of Thun, which lies in the Bernese Oberland region, has erected a municipal lighting and power plant of considerable size. The plant is operated by hydraulic power, which is obtained from the river Aar, a stream flowing by the city. The river was used before the present station was erected to supply a hydraulic plant which furnished power for the city water pumps and for other purposes. At the time of building the new plant and the dam which was needed for it, the work was laid out so that the two plants should be run from a single system, and the same hydraulic construction serves for supplying both these plants. At the same time, the old plant is called upon to furnish a part of the current in connection with the new station.

The turbines in the old station take about 280 cubic feet of water per second, and the wheels, which have been placed in the new hydraulic plant, have a capacity of 210 cubic feet per second. The Aar river is divided into two branches at a point above the principal dam. The intake canal starts from a point above the main dam, and leads directly to the new hydraulic station, then passing along the bank to the old hydraulic plant. These two stations, according to the figures just stated, require a total of 490 cubic feet of water from the stream. The minimum supply which the lake of Thun affords to the Aar river, which is an affluent of the lake, is only 700 cubic metres per second, with a fall of ten and three-quarters to fourteen and one-half feet. Under these conditions at least seventy per cent of the total water supply must be taken off by the intake canal for use in the two hydraulic plants. As the ground, which forms the banks on either side of the dam, is broken by irregularities and fissures, the losses of water might be considerable unless special precautions were taken in building the dam at the points where it joins on to the banks. At the time of erecting the new hydraulic plant the intake canal, which previously existed here, had to be enlarged and also brought to a point higher up stream than before. At the starting point of the canal a bridge thirty-three feet long was built across one of the branches of the Aar for operating the locks, which are constructed at this point.

The station building, which is erected between the river and the intake canal, is shown in the different views. The sections of the station and the plan views show the disposition of the vertical-shaft turbines and the dynamos. The turbines are placed in a masonry and cement construction which lies below the level of the main dynamo room containing the alternators. At one side of the dynamo room is the main switchboard. The photograph shows the two alternators which have already been set up in the station, and arrangements have been made for putting in a third machine, should the demand for current increase in the future. The main switchboard is installed in a gallery which stands six and one-half feet above the main floor of the hall. It is reached by a staircase which leads from the middle of the room. Under the gallery will be noticed the upper ends of the turbine shafts and the bevel-gearing which connects them with the alternators.



PLAN AND SECTIONAL VIEWS OF THUN STATION.

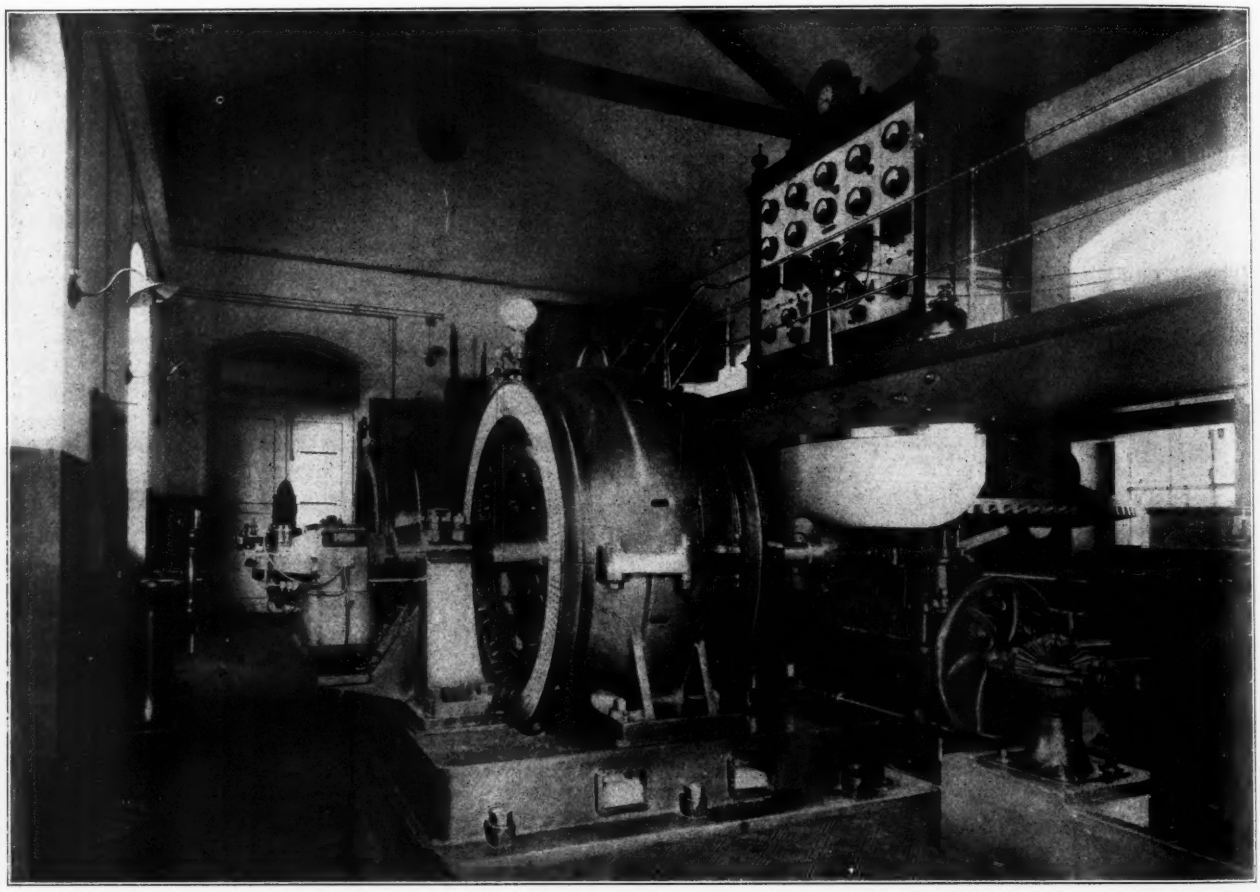
The two turbines of the Thun station have been furnished by the firm of Thomas Bell, from the factory at Kriens. These wheels are of the reaction pattern and are provided with aspiration tubes, according to a system which has been recently patented by the company. The normal capacity of these wheels is 100 horse-power each, at a speed of seventy revolutions per minute, with a water flow of 2,300 to 2,800 litres per minute, and a head of water varying from ten and three-quarters to fourteen and one-half feet. The aspiration tubes, which are constructed of beton, are used in this case owing to the great variation in the height of the fall. The turbines are provided with speed-regulating devices. These consist of a ring, which is made to rise and fall so as to allow a greater or less amount of water to pass to the wheel, in connection with an automatic governor which is operated from the shaft of the turbine, and is made to control the movement of the regulating ring. This device gives a very good speed regulation for the wheel, and when operating at a speed of 700 revolutions per minute, it is said to control the speed within three per cent. The bevel-gearing, which transmits the movement of the vertical-turbine shaft to the horizontal shaft of the dynamo, consists of a large bevel wheel mounted on the end of the shaft and a smaller gear which works on the underside of the former. The teeth of the small gear are faced with rawhide, and in spite of the large ratio of transmission, which is 70:300, the wear of the rawhide against the iron is found to be very small, and the gearing gives scarcely any noise in working.

The two alternators of the Thun station, which have been furnished by the Oerlikon Company, are of the inductor pattern and deliver three-phase current, at 1,900 volts and fifty cycles, with power-factor of 0.85. They are built to give a capacity of 100 kilowatts, and under normal working make 300 revolutions per minute. Both the armature and the field windings are fixed, and are placed in a laminated ring. The latter is lodged in the interior of the main circular cast-

ing which forms the body of the machine, and is built in two halves. On the shaft is mounted the rotating part or inductor, which consists merely of a drum of large diameter built of cast iron, carrying two ranges of ten pole-pieces disposed around the periphery. One set of poles corresponds to the field winding of the ring and the other set to the armature winding, as is usual in this type of machine. The mechanical construction of these alternators is especially solid, and this gives great security in case of racing of the machines. The armature part of the laminated ring is provided with 120 slots, in each of which are lodged nineteen copper wires of 0.16 inch diameter. The armature bore is 3.93 feet in diameter. Each of the alternators is provided with a separate exciter of the upright two-pole type, which is mounted on a bracket cast with one of the bearings of the machine. The field coils of the alternator consist of 480 turns of 0.32 inch in diameter copper wire. The exciting current for this winding is normally fourteen amperes at fifty-five to sixty-five volts.

The wires which carry the exciting current, as well as the high-tension wires of the alternators, are brought to the switchboard by conduits placed below the level of the station floor. The switchboard, which is mounted in the middle of the gallery, carries the apparatus for the alternators and exciters, also for the high-tension lines which leave the station. The first of the marble panels forming the switchboard (starting from the left) contains an ammeter for the main current, a phase-changing switch or commutator for the high-tension circuit, also an ammeter and a main switch for an independent line which runs from the station to a sawmill about 250 yards distant, and supplies a three-phase motor. The other three panels of the board carry the apparatus for the two machines in the station, and also for a third alternator, which is located in the annex station, as will be mentioned further. Each of the panels carries an ammeter, a voltmeter for high tension, a switch and a phase-indicating lamp, besides an ammeter for the exciter, a carbon point switch for the same, and the hand-wheel of the rheostat. The fifth panel carries an ammeter, a voltmeter, a switch for the transformer, which is located in the station building, as well as a phase-changing switch for the high-tension circuit. Behind the switchboard are placed the three rheostats of the exciter circuits, four transformers for the measuring instruments and the fuse-blocks. The fuses and lightning arresters are enclosed in special cases.

Since the two alternators were first installed in the turbine station, the demand for current began to exceed the capacity of these machines, and in order to provide an additional supply of current during the hours of heavy load it was desired to erect a third alternator which would help out the other two. This extra machine was not, however, set up in the main station, but space for it was found in the old station, which was already equipped with a set of turbines for operating the pumps of the city water supply. This plan proved to be a decided advantage, seeing that both the turbines in the latter station only worked for a period of twelve hours, and in the remainder of the day one of the wheels could be used to supply the pumps and the other one was thus available for use with an alternator, as otherwise it would have remained idle. Accordingly a three-

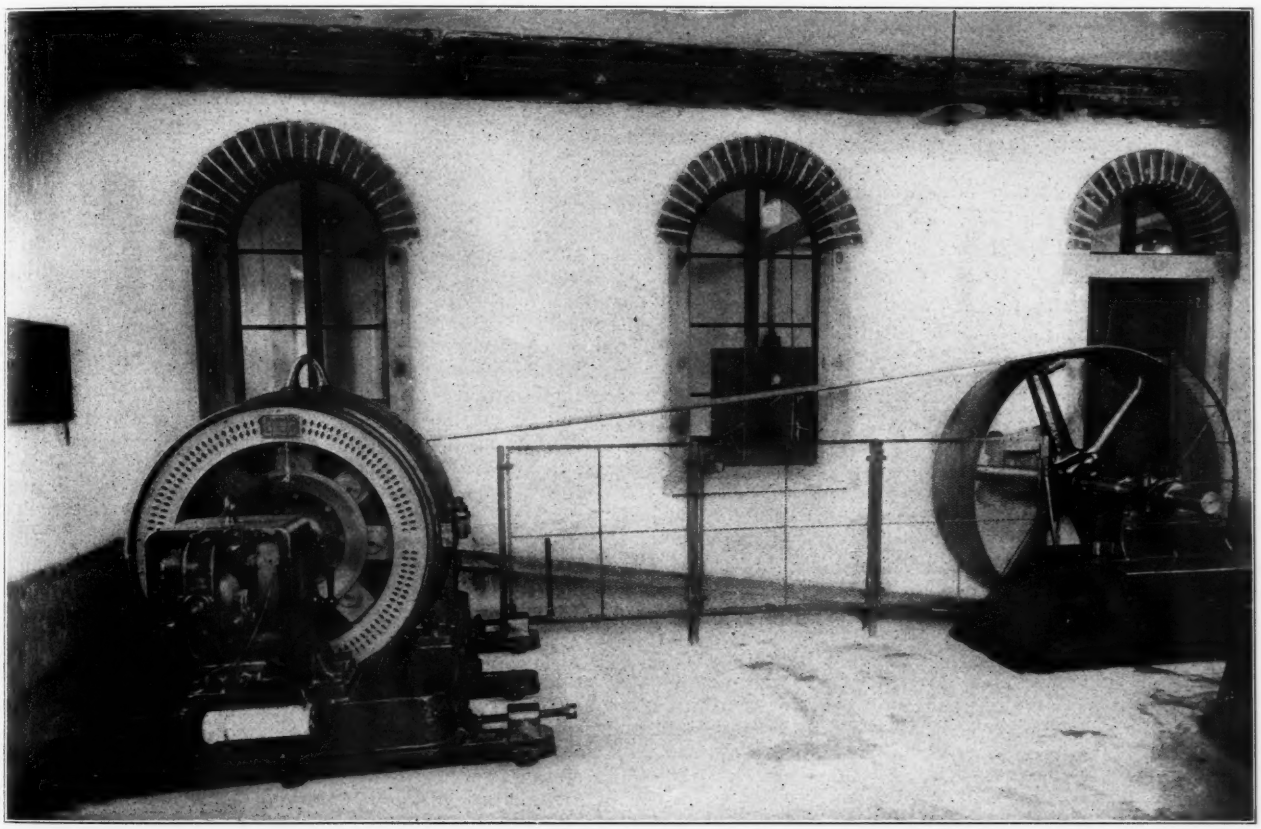


THE MAIN STATION OF THE HYDROELECTRIC POWER SYSTEM AT THUN, SWITZERLAND.

phase machine of the Oerlikon pattern was installed in the old turbine plant, as one engraving shows, and it comes into use to furnish current on the high-tension lines during the hours of heavy load, at other times acting as a reserve. An annex was added to the station building in order to provide space for the new machine. On the main horizontal shaft, coming from the turbines, is mounted a six-foot pulley. The shaft is provided with a clutch for throwing the pulley on or off. The alternator has a corresponding pulley of two feet in diameter, which is connected by belt with the large pulley. This machine, like the alternators in the main station, is built on the inductor principle, and it is of about the same capacity. In the engraving the construction of the inductor, with its eight projecting pole-pieces, can be easily noticed. The alternator has a capacity of eighty-two kilowatts, and is operated generally at 375 revolutions per minute. Like the other alternators, it delivers 1,900 volts at the terminals with a frequency of fifty cycles, having a power-factor nearly equal to unity. The construction of the alternator is of a later date, and the windings are somewhat different. Each half of the armature is provided with forty-eight rectangular slots, in which are placed twenty-four lathe-wound coils. Each of the armature coils is made up of twenty-seven turns of a 0.14-inch copper wire. The two halves of the armature are connected in series. The exciter, which is mounted on a bracket against the machine, is of a horizontal, rectangular pattern, and differs from the exciters on the other alternators. The regulation of the exciting current from the present alternator, as well as the coupling in parallel with the other two machines, is carried out from the main switchboard of the central station, as has been noted above. However, the second plant is provided with a small switchboard, which is mounted beside the alternator, and it carries an ammeter and voltmeter, also a switch for the main current. This second station is situated at a distance of 120 feet from the central station. It is to be remarked that the turbine which drives the third alternator is not provided with any speed-regulating apparatus, and therefore can not be governed. In this case the alternator is always made to run at full load, and it is the two main alternators which in reality are called upon to give the additional current during the hours of heavy load.

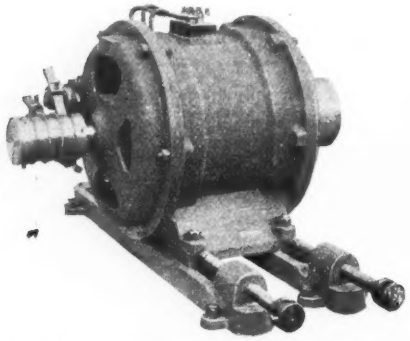
As regards the system of current distribution for the city of Thun, it may be stated that two high-tension lines, having the voltage which is furnished direct from the machines, or 1,900 volts, lead from the station. One of these lines, which forms the main circuit for the town supply, is a cable formed of three 2.8-inch wires. This cable is laid underground, at a depth of 2.6 feet below the surface. It rests upon a bed of sand and is covered with tiling, so as to be well protected. The cable runs from the plant into the city. At the Allemend bridge it divides into two parts, which come together again at a point somewhat further on, and from thence it proceeds to some distance in order to reach the transformers, which lie at the last of the series and are used to supply some of the large hotels. This cable is used for the main light and power distribution within the city and passes by a number of transformer stations, which lower the voltage for the secondary mains. The highest drop in voltage on the feeder lines is two per cent. The second feeder cable, which was mentioned above, leads from the station to a large sawmill some 750 feet distant, where it supplies the three-phase motors for operating the mill.

The transformers, which are connected with the main circuit, lower the tension to 120 volts. Most of the transformers



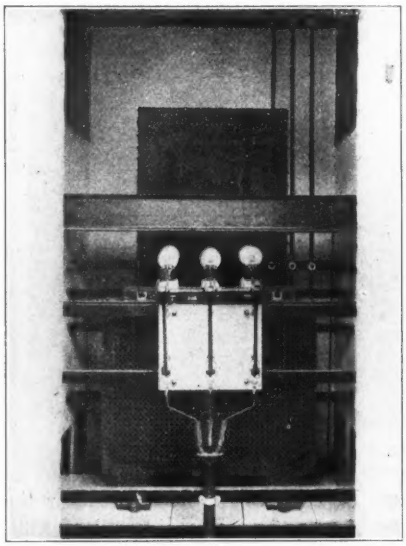
THE SECONDARY GENERATOR IN THE OLD TURBINE STATION OF THE HYDROELECTRIC POWER SYSTEM AT THUN, SWITZERLAND.

are placed within the city limits, either on the houses or in small brick constructions which have been built to contain them. The capacity of the transformers varies from forty kilowatts down. One engraving shows one of the larger sizes of transformer. They have been furnished by the Oerlikon Company and are composed of three laminated iron cores which are connected at the top and bottom by



THE LOW-TENSION THREE-PHASE MOTOR.

a heavy yoke, which is also formed of laminated iron. Around the cores are placed the primary and secondary coils, which are concentric. To take off the coils it is only necessary to remove one of the end-plates, and this can be easily done. A perforated sheet-iron guard



ONE OF THE SPECIAL TRANSFORMERS AT THE THUN HYDROELECTRIC STATION.

is placed around the transformer. In front of the transformer will be observed the method of mounting the primary switch. The connection of the primary cable with the switch is made so that it can be very easily removed.

The three-phase motors which are used on the Thun circuits are of two different kinds. One of the types of motor is designed to be coupled directly upon the high-voltage cable, while the second form is used on the 120-volt circuit. At present there are two of the high-tension motors in use. One of these is placed in the sawmill, which we have already mentioned, and the second motor is used in a paper factory which lies not far distant. These two motors are supplied from one of the main cables of the station. The motors are provided with three contact-rings, which allow of placing a resistance in the armature circuit when the motor is started up. The operation of these motors is simple and there is no danger from their use.

Both lamps and motors on the secondary circuits are made to work at a uniform tension of 120 volts. Most of the secondary wiring is placed underground. Overhead wiring occurs but rarely, and crossings of the circuits are avoided as much as possible. Each of the circuits is provided with a lightning arrester, which is located either in the transformer house or at the point of consumption. A good supply of lightning arresters is used on the poles. Inside the city all the secondary mains have been placed underground. A number of low-tension, three-phase motors are used at present on the secondary circuits. One of the engravings shows one of the latest types of small motor which has been built by the Oerlikon Company. Like the high-voltage motor, it is provided with a ring-collector for throwing in a starting resistance. These motors are placed either on the secondary circuits or directly upon the terminals of the transformers. They are now used in sizes which range from one-quarter up to six horse-power. A number of them are used to work air-fans.

As regards the use of the current for lighting, it is to be noted that the greater part is employed for private lighting. Owing to the fact that the city is engaged in operating the gasworks, and the use of gas lighting in the streets for a long time past, it was not found desirable to use the current to any great extent for the street lighting. However, some of the central parts of the city, which require an extra amount of light, have been provided with a certain number of arc and incandescent lamps. As to the method of mounting the arc lamps, it was found unfavorable to place the lamps directly on the lines, and at present they are used in connection with transformers to which they are connected. The transformers for the arc lamps are placed in certain special stations or cabins and are equipped with fuse-blocks, regulating resistances, and also with switches which can be worked from the outside of the cabin. For the city lighting, the incandescent lamps are usually branched upon the private lighting circuits. Lamps of sixteen and twenty-five candle-power are used in both cases. Electric cooking devices have proved a favorite in the city of Thun, and a considerable number of these are now in operation.

The Surface-Contact System of Electric Railways in England.

Consul Mahin, of Nottingham, England, reports the experience of Lincoln with the surface-contact system as follows:

"The town of Lincoln, with 50,000 population, thirty-three miles northeast of Nottingham, has adopted a street-railway system which has several unique features. Construction is now under way. The line will be about a mile and three-quarters in length, eight cars will be used, and the entire cost will be about $140,000. The surface-contact system was adopted by the Lincoln city council after long and careful investigation and consideration, and the securing of guarantees that place the corporation beyond possible risk of loss, such, for instance, as an undertaking by the constructors of the line to equip it with the trolley if their system failed to work satisfactorily. The system adopted is known as the 'G. B. surface contact.' The initials stand for Griffiths & Bedell, the patentees. The inventor is Mr. B. H. Bedell, an electrical engineer. The invention was substantially completed in 1904."

The Underwriters' Laboratories at Chicago, Ill.

A brief description of the new building of the Underwriters' Laboratories at Chicago, Ill., is given in *Insurance Engineering* (New York) for November. The new building is on Ohio street, and occupies a plot of ground 100 feet square. One-half of this is covered by the building, which is 50 feet by 100 feet. It is three stories in height, with a basement. The remaining part of the site has been reserved for storage purposes and for the erection of fire-testing ovens. The basement is entirely of fireproof construction, the only wood about the building being the 10,000-gallon reservoir adjoining the basement. The walls are of solid brick, and the windows are protected with wired glass set in hollow metal frames and sash. The floor beams are of steel and the columns of cast iron protected by terra-cotta fireproofing. The floors are of reenforced hollow tile construction. The partitions are built of tile set in steel frames and reenforced. The top floorings consist of cement and "endurite." The building is free from dangerous concealed places, as the walls and floors are solid. The building is to be fitted with the most modern forms of fire-extinguishing apparatus, both of the automatic and the manual types.

Chicago Street Railway Companies.

A report on the probable gross earnings and division of profits between the Chicago, Ill., street railway companies and the city of Chicago has been submitted to the committee on local transportation of the Chicago city council by Mr. Bion J. Arnold, the committee's consulting engineer.

In arriving at the conclusions stated in the report, many conferences between the companies' engineers and Mr. Arnold have been held, with the result that the following premises have been agreed to and accepted by all:

That curve L, of plate fourteen of the Arnold report of 1902 (which plate accompanies the report) represents the probable gross earnings of the city railways of Chicago, from 1906 to 1925, inclusive. That the operating expenses, including maintenance, may be taken at sixty per cent of the gross earnings. That the valuation of the physical property as given in column B of the same report, may be accepted as the present valuation, after making allowances for additions and depreciation since the report was made. The cost of rehabilitating the property of the company is fairly stated in Mr. Arnold's letter of June 25, 1903, a copy of which accompanies the report, this amount being $16,560,077; and $10,000,000 will be expended for extensions and in additional equipment between 1911 and 1925. The average depreciation of all physical property after rehabilitation will be five per cent per year, and the interest rate on new money for rehabilitation purposes will be five per cent.

In the following abstract of this report, the totals only are given. The gross earnings, as derived from curve L, will be $240,111,000; the operating expenses sixty per cent of this, or $144,067,000. The net earnings will be $96,044,000.

To determine the physical value of the property on November 1, 1905, to the previous valuation of November 1, 1902, is added the cost of reconstruction and equipment added since that time. From this figure depreciation at the rate of five per cent per year must be deducted for the original equipment and for what has been added. This reduces the total value of the physical property to $13,192,231 on the date mentioned. The cost of reconstruction, as estimated in the Arnold report of June 23, 1903, is $16,560,077. The estimated cost of additional equipment after 1910 is $10,000,000. The cost of renewals on the investment in fifteen years is estimated at $3,200,000. This amount, distributed over twenty years, is equivalent to an annual renewal cost of $160,000, which is equal to four per cent on $4,000,000. From these figures it is estimated that the total renewal cost for the twenty-year period will amount to $27,001,000, leaving for net earnings, less renewals, $69,043,000.

From this figure of $69,043,000 must be deducted $7,203,000 for taxes; $14,076,000 for interest on cost of reconstruction; $4,000,000 for cost of additional equipment and extensions; $15,005,000 for sinking fund payments to provide for the extinguishment by 1925 of the value of the present franchise and ordinance rights; compensation to the city of Chicago, $17,836,000—a total of $69,043,000; leaving for dividends $10,923,000, which is at the rate of 1.437 per cent per year for twenty years, on the total value of the property of $38,000,000.

From the above it will be seen that the company, on the basis set forth, would earn a sufficient amount during the twenty-year period to retire its present assumed franchise value of $25,000,000, and, in addition, pay an annual dividend of 1.437 per cent on the combined value of this franchise and the value of the present physical property.

Assuming the above franchise value to be correct, this dividend can be increased in but three ways: by an increase of gross earnings; by decreasing the operating expenses, or by borrowing reconstruction and new equipment money at a lower rate than five per cent. For each per cent decrease in operating expenses, the above interest rate on a valuation of the total property of $38,000,000 would be increased by 0.316 per cent. To produce an annual income of four per cent on the $38,000,000 would necessitate operating for 51.84 per cent of the gross receipts—a figure not probably attainable.

By borrowing money at four per cent instead of five, the annual dividend rate would be increased to 1.91 per cent.

If, on the other hand, the company should fail to realize five per cent on its sinking fund payments, then for each successive one per cent decrease below five per cent, the annual dividend rate on the $38,000,000 will decrease by 0.22 per cent, 0.24 per cent, and 0.26 per cent, respectively.

If the gross earnings of the $240,111,000 for the twenty-year period should not be realized, and the operating expenses remain at sixty per cent, then for each one per cent those earnings fall below the above figure, the annual dividend rate would fall by 0.126 per cent.

A decrease of 11.4 per cent in the gross earnings would reduce this dividend to zero.

Of the above statement of expenditures by the company, there will be a direct return to the public in taxes, compensation to the city of Chicago, street sprinkling, cleaning, track elevation, paving and renewals of paving, of $34,643,000, amounting to 14.428 per cent on the gross earnings.

A table is given by Mr. Arnold showing the resulting annual dividend rate, and the corresponding value of the entire property for various assumed values of the franchise. This, at the present time, is taken at $25,000,000, and the annual dividend is 1.437 per cent. If the value of the franchise is $10,000,000, the annual dividend will be 4.347 per cent. If the value of the franchise is assumed to be nil, the annual dividend will be 10.016 per cent.

The report states that it has been impossible to prepare in detail reports for the North Chicago and West Chicago street railway companies. Since, however, it is not probable that a close analysis of these properties would show a condition more favorable than that of the Chicago City Railway Company, and as these companies offered to pay the city the same rate of compensation offered by the Chicago City Railway Company, it has not seemed necessary to prepare more detailed statements. A table, however, is given of the estimated total yearly receipts for the three companies mentioned. The gross receipts for all three companies for the twenty-year period from 1906 to 1925, are estimated at $546,851,000.

Mr. Arnold calls attention to the fact that it is not part of his duty to express an opinion upon the correctness or incorrectness of the assumed franchise value or rates of compensation to the city given in this report. It has been necessary for him to assume these as conditions precedent to his analysis.

In concluding, he calls the attention of the committee to the necessity of formulating, before final conclusions are reached, some practical plan for ensuring the city that whatever amount of money is finally agreed upon to be put into properties for rehabilitation and renewals by the companies will actually be expended upon the properties in the manner agreed upon, in order to ensure the quality of service and maintain the properties at a high standard of efficiency, which it is assumed such an investment will give.

American Institute of Electrical Engineers.

The 202d meeting of the American Institute of Electrical Engineers was held at the Edison auditorium, New York city, Friday evening, December 15. The meeting was called to order by President S. S. Wheeler. Mr. Sydney W. Ashe read his paper on "The Relation of Railway Substation Design to Its Operation." This paper deals with the following questions regarding substation operation: the best method of starting synchronous converters; the protection of converters; the use of oil switches when synchronizing; the regulation of load; the best arrangement of switch gear; the operation of reverse current relays; the adjustment of load between the substations which feed the same circuit, and the operation of synchronous converters. Each of these questions is taken up somewhat in detail by Mr. Ashe. A fuller abstract of this paper will be published in an early issue of the ELECTRICAL REVIEW.

The second paper presented during the evening was by Mr. C. W. Ricker, of New York city, and is entitled "Some Considerations Determining the Location of Electric Railway Substations." Mr. Ricker shows how the varying factors of cost, construction and operation may be plotted graphically, so that a design of station giving the minimum cost for substation operation may be adopted. This paper will also be published in a later issue.

The discussion on the two papers was opened by Mr. H. A. Lardner, of New York city, who asked a number of pertinent questions. He said that direct current is not always available at substations for starting the synchronous converters, so that it is, in many cases, essential that some alternative method of starting be provided for. He asked whether provision may not be made in some other way than by means of auxiliary storage batteries for operating the remote control switches, whether they could not be worked directly from the direct-current bus-bars? Another method of starting, which was not touched upon by Mr. Ashe, consists in carrying the speed of the rotary above synchronism, then disconnecting it from its source of power, and allowing it to drop back, throwing it on to the alternating-current bus-bars at the moment it reaches synchronism. Mr. Lardner said that starting from the alternating-current side has considerable advantage sometimes; that he has seen this method employed for converters rated at 500 kilowatts without any difficulty being caused or any hunting taking place. Mr. Lardner questioned the value of boosters, as suggested by Mr. Ricker, for extending the section of road to be fed from one substation.

Mr. W. I. Slichter, of Schenectady, N. Y., mentioned another method available for starting synchronous converters by means of a single-phase-commutator motor, which can take the place of the induction motor often employed. By introducing reactances in series with the motor, the speed of the latter can be controlled easily, and no difficulty is met in synchronizing.

Mr. J. B. Taylor, of Schenectady, N. Y., said that reactance coils are used with rotaries mainly to make regulation and an even division of the load possible. In substation design it is becoming customary to arrange for starting at one-third normal voltage. This is to provide against unusual conditions which might lower the voltage to a point where the rotary could not be started. Mr. Taylor said that there are two general conditions met with in substation design. The first is that when a railway system alone is supplied from the substation. In this case variations in the voltage of the system caused by starting the rotary are of no consequence. In the other case the substation must supply a large mixed system consisting of railway and lighting loads. Such a substation will, in general, be part of a system so large that the variations in voltage caused when starting it are not felt. Mr. Taylor said that, regarding the use of bridges and other anti-hunting devices on rotaries, in general these are not essential, as there is no tendency for the machines to hunt when they are omitted.

Mr. H. G. Stott, New York city, spoke of the difficulty of throwing rotary converters in synchronism when there is a fall of potential on the line of over twelve per cent. Starting one rotary from the alternating-current side may provoke hunting of other machines. This factor is a limiting condition in the location of substations, for they must be so close together that the maximum drop in voltage will be fifteen per cent.

Mr. E. H. Hewlett said that pumping of motor-operated switches was a thing of the past, since they are now made with stops which are automatically thrown out of the way at the first movement of the motor, but hold the switch in place after it has been moved.

Mr. D. B. Rushmore, of Great Barrington, Mass., said that what was frequently taken for hunting of the rotaries is merely the effort of the rotary to follow the angular variation in speed of the generator. With the introduction of the steam turbine, which gives a uniform speed of rotation, this effect will disappear.

Dr. R. B. Owens, McGill University, Montreal, Canada, said that it seemed that one important item in the consideration of substation location had not been touched upon in the papers of the evening. This is the question of voltage. For some reason or other, the voltage of direct current for electric railway systems has not been carried beyond 600 or 650 volts. This seems strange, as he believes that the manufacturers stand ready to furnish rotaries for 1,000, 1,500 or even 2,000 volts direct current. They are also prepared, if called upon, to supply motors to be operated at these voltages, these motors being of the bipolar type, with which satisfactory commutation can be secured. This plan, it would seem, would affect considerably the entire question of electric railway design, and was, in effect, the answer of the direct-current system to the alternating.

Mr. William McClellan asked whether the plan described by Mr. Ricker would help in locating substations except when the territory is more or less general and presents no special problems.

The discussion was closed by Dr. C. P. Steinmetz, of Schenectady, N. Y., who, in his usual manner, gave a masterly summary of the topics under discussion. Dr. Steinmetz divided substations into two classes: those operating on large systems, where, necessarily, the voltage variations must be small. In these cases automatic control of the voltage is not necessary, and is avoided as an unrequired complication. In the other class—that of interurban railway systems where the stations are of moderate size—the heavy drop in voltage can not be prevented with any investment in copper which can be considered. For such substations automatic voltage regulation by means of reactance coils and powerful fields on the rotary must be employed. It is what is usually known as phase control. Dr. Steinmetz said that, in practice, the starting of synchronous converters from the direct-current side of interurban systems has failed, since it is impossible to perform this operation with any degree of satisfaction when the voltage of the line is varying as greatly as is the case. For this reason, starting from the alternating-current side has become an accepted practice. There is then

no need to synchronize, as the machine takes care of itself. A modification or a compromise between the two systems can be adopted in order to reduce the starting current. The machine may be brought up to speed from the direct-current side, then disconnected entirely from this side, and the alternating-current switches thrown. The proper moment for closing the main switches is just before synchronism is reached, not after. Dr. Steinmetz divided anti-hunters into three classes. The most perfect of all is the Leblanc amortisseur, a squirrel-cage winding embedded in the pole-faces. This prevents distortion of the main field. The second class consists of a bridge placed between the pole-faces, which resists the action of a vertical component of field distortion set up by the armature. The third class is the short-circuit around the poles, acting somewhat in the same way.

The meeting then adjourned.

The Turbine Steamer Carmania.

The officers of the Cunard Steamship Company entertained the representatives of the press of New York city at lunch on board its new steamship, the Carmania, on Tuesday, December 12. This magnificent steamship is a noteworthy addition to the Cunard fleet, as she is the first large ocean steamer to be propelled by steam turbines. The vessel is 675 feet long, 72.6 feet beam, with a displacement tonnage of 30,000. She is ninety-seven feet deep from bridge to keel, and has a speed of twenty knots. She is not only the largest turbine steamer in the world, but one of the largest of the transatlantic fleet. The turbine equipment consists of three turbines of the Parsons marine type. These drive directly three propellers. The central turbine is a high-pressure unit, the others being low pressure. The latter two are fitted with auxiliary blades for going astern.

The behavior of the machinery during the voyage is said to have been most satisfactory, although unusually bad weather was encountered, the trip being made in schedule time. Throughout the voyage no accident whatever occurred, and the turbines required almost no attention. It is said that they do away with the vibration of the ship almost entirely.

The electric generating plant of the ship is located abaft the engine room on the orlop deck. The equipment consists of four generating sets, each rated at seventy-five kilowatts, and running at 450 revolutions per minute. There is here also a large switchboard, from which thirty-six circuits are carried. Sixteen of these are for lighting the ship, and ten for the ventilating fans and for thermo-tanks. Three are heating circuits for the electric heaters distributed throughout the cabins, three for turbine lifting gear placed in the engine room, two for boat hoists, one for the searchlight projector, and one for galley machinery.

The double-wire system is used in lighting. The mains for each circuit run from the switchboard to a junction box, where there is a double-pole fuse. From this box, circuits are carried to other boxes, where fuses are placed, from which, in turn, circuits are carried to the distributing boxes. Not more than three lamps are connected to any one circuit. The total equipment of lamps is about 2,650.

The thermo-tanks referred to above are large chambers through which fresh air is supplied to various parts of the vessel. The air, as it passes through these tanks, can be heated by steam coils or cooled if desired. The air from the tanks is driven, by means of centrifugal fans, throughout the air ducts. There are four of these fans, twenty-five inches in diameter, each requiring seven and one-half horse-power to drive it. These fans are located on the lower deck, and ventilate the stoke holes. The engine room and dynamo room are ventilated by four twenty-inch fans, each requiring five horse-power to drive it. The ventilation of the saloons and staterooms is accomplished by a seventeen and one-half-inch fan, located on the boat deck. The first-class smoking-room is ventilated by a twenty-inch fan, while a twelve and one-half-inch fan is used for ventilating the second-class smoking-room. There are six twelve and one-half-inch fans for ventilating the first and second-class lavatories. Three twenty-five-inch fans are fitted in the hold, ventilating trunks, to assist the natural ventilation of the vessel.

Electric heaters are used for warming the first-class dining saloon, where there are four large ornamental heaters, two placed at each end of the saloon. Each of these absorbs about twenty amperes. There are two similar heaters, smaller in size, in the writing room. Six staterooms on the promenade deck are each fitted with two heaters, and five smaller staterooms have one heater each. These heaters take a current of seven amperes. Each first-class bathroom on this deck is warmed by a small heater placed on the wall near the door, taking five amperes.

The motor equipment is employed for various purposes. Those attached to the turbine-hoist apparatus are three in number, and rated at eighteen horse-power. These are for lifting the turbine cases and rotors, when such is necessary, for inspection or repairs. There are two electric winches on the boat deck, three electric hoists in the storerooms on the lower deck for raising supplies to the galleys and pantries. These latter are one 500-pound hoist and one 300-pound hoist for supplying the first-class galley, and a 300-pound hoist for the third-class galley. In addition, there is a 200-pound coal hoist for supplying coal to the first-class galley. Another hoist is placed in the mail-sorting room, which can lift five hundredweight at 150 feet per minute. The galleys are equipped with electrically operated machinery as far as possible. There are a dough-mixer, a roaster, three dish-washing machines for the three pantries, and six grills in the various pantries and barrooms. There are also a number of other small apparatus driven by motors, such as knife-cleaners, hair-brushes in the barber shop, and an electrically heated hot-water urn.

The shop telephone service serves for communicating from the wheelhouse to the engine room and the lookout at the forecastle, and to the steering gear at the after end of the shelter deck. The telephone at the forecastle is of the portable type, which can be removed when not in use. There are also intercommunicating telephones fitted in the staterooms, the cabin, in the chief steward's and chief engineer's rooms, and in the lower steering compartment. The ship is fitted throughout with an electric call-bell system of 420 positions. There are also a submarine signal system and a Marconi wireless-telegraph system, the latter being installed in a special cabin.

The ship is fitted throughout with the Stone-Lloyd system of operating watertight bulkhead doors. These can all be closed in a few seconds from the bridge, and there is an indicator for each door, showing whether it is closed or not.

The whistle, which is fitted in the forward funnel, can be operated electrically from any one of three positions on the bridge.

The Illinois Valley Railway Company has published a handsome booklet entitled "The Illini Trail." This booklet is replete with beautiful illustrations, and is descriptive of the valley of the Illinois. Many points of scenic beauty and historical interest are detailed, and there is included the story of "Starved Rock."

THE NEW YORK ELECTRICAL SHOW.

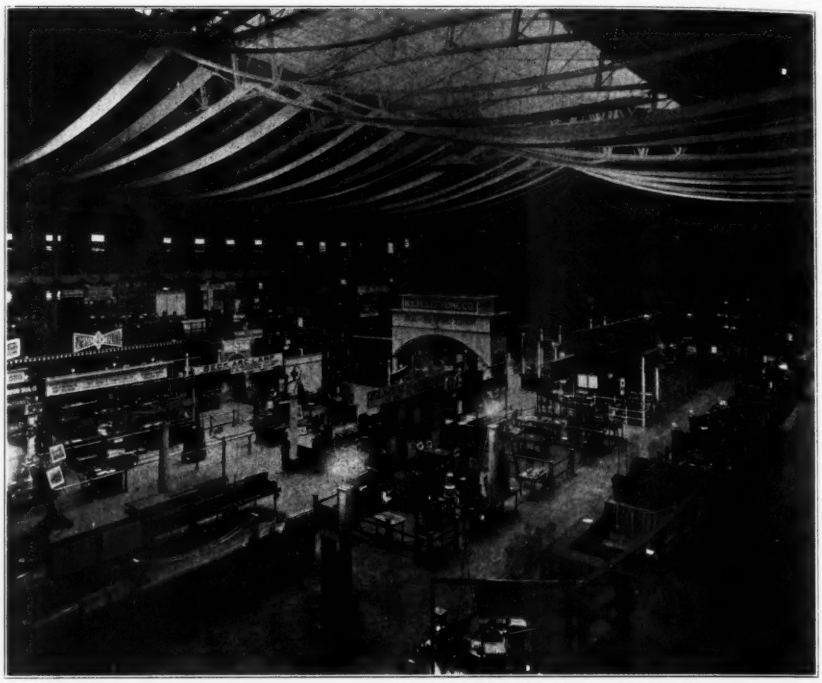
THE ANNUAL ELECTRICAL AND MECHANICAL SHOW, HELD AT MADISON SQUARE GARDEN, FROM DECEMBER 12 TO DECEMBER 23, ATTRACTS MANY VISITORS.

The opening of the electrical show in Madison Square Garden, New York city, on December 12, was chronicled in the last issue of the ELECTRICAL REVIEW. At that time a brief enumeration was given of the exhibits. Upon entering the corridor of Madison Square Garden leading to the large amphitheatre, the visitor is at once impressed with the advances of electricity for illumination. Running completely around the large corridor is a Moore vacuum tube, lighting up the entire entrance with a steady, pleasant light. This is really the exhibit of the Moore Electrical Manufacturing Company, of Newark, N. J.

Upon entering the amphitheatre, the first exhibit which greets the visitor is that of the American Electrical Novelty and Manufacturing Company, New York city. This is probably the most extensive exhibit of electrical novelties ever shown at one time. The display is ingenious and very attractive. On one end of the booth is shown a movable showcase fixture, which consists of a series of trays constantly moved in a vertical direction. The miniature lamps and portable lights of every description are automatically flashed in circuit as each tray reaches the window or showcase level, the current being turned off as the tray recedes toward the back of the window. In this booth there are exhibited electric gas lighters, clock lamps, flashlights, candelabra and decorative fixtures of every description. Complete Christmas-tree outfits are shown, suspended from two large firs on either side of the hall. A feature of this company's exhibit is the guaranteed electrical self-winding clock. This clock is claimed to be absolutely perfect in construction and operation. The company was represented by Mr. F. J. Alvin, manager; Mr. George W. Edge, assistant manager; W. G. Mills and C. Hubert

The representatives of the Electro-Dynamic Company, Bayonne, N. J., were kept busy explaining the advantages of the "Inter-Pole" motor. In this company's booth there were exhibited various types of Moloney transformers. The exhibit showed the transformers complete with hanger-irons attached, and also showed various small parts of the assembly. A working exhibit of the "Inter-Pole" motor driving another motor as a generator was shown also. Connected up with the apparatus were a speed-indicator, a voltmeter and an ammeter. Demonstrations were constantly given of the speed ranges of this motor, and the adaptability to instantaneous reversals and changes with sparkless commutation and without shifting of the neutral points. The Electro-Dynamic Company was represented by Mr. G. Herbert Condict, Mr. Thomas B. Peck, Jr., Mr. H. McL. Harding, J. B. Van Doren, and H. V. Neefus.

The exhibit of the Waterbury Company, New York city, was very elaborately and handsomely arranged. In this booth there were shown very complete lines of Manila, sisal and wire rope, music wire, seamless rubber-insulated wire, paper-insulated lead-covered cable for telephone, telegraph and power service, switch and panelboards

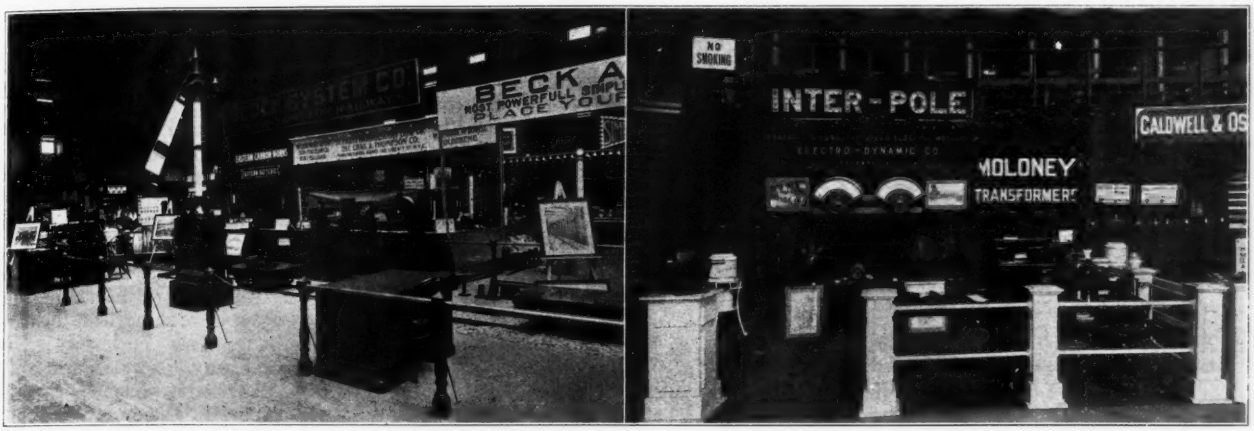


GENERAL VIEW OF MADISON SQUARE GARDEN ELECTRICAL SHOW, NEW YORK CITY.

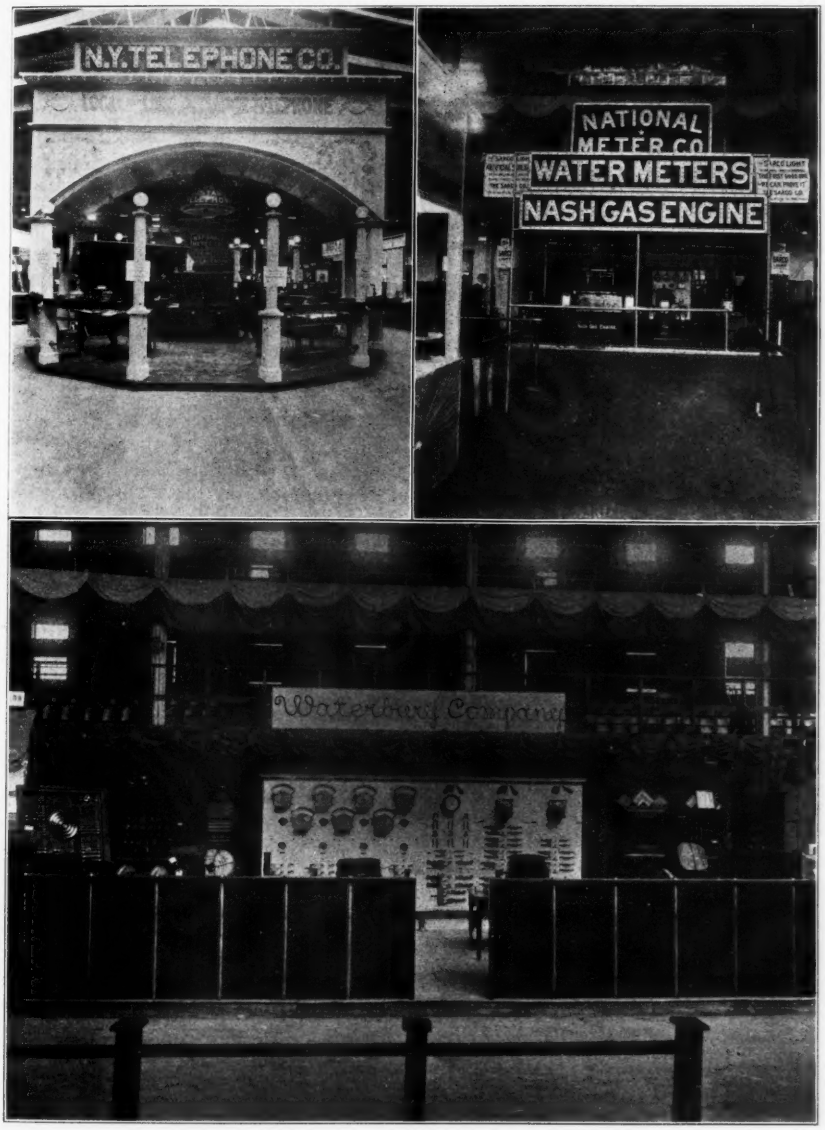
GENERAL VIEW OF MADISON SQUARE GARDEN ELECTRICAL SHOW, NEW YORK CITY.

and switches. The new take-down wall box was shown, and demonstrations were given of its adaptability to all forms of construction. A feature of the exhibit was the practical demonstration of the method of marbleizing slate and other materials so as to match-up with the switchboard marble or other marble trimmings. A complete marbleizing outfit was installed, along with the baking ovens and other necessary apparatus. A feature of the exhibit which attracted a great deal of attention was a new $10,000 switchboard built for the new Harlem hospital, New York city. This board is equipped complete, as it will be installed in the hospital plant. All of the fixtures on the switchboard are finished in polished and lacquered brass, making an extremely handsome appearance. The board is mounted on the new pedestals designed by the Waterbury Company. These pedestals consist of a wrought-iron tubular stand, surmounted by a solid brass bushing, and covered with a ribbed bronze tubing and a stamped bronze shell. This form of construction makes a decidedly attractive pedestal, gives ample strength, and does away with the possibility of flaws from solid castings, at the same time bringing the cost down to a minimum. The company was represented by Francis Granger, purchasing agent; T. J. Murphy, superintendent switchboard department; O. Monroe, superintendent of rubber-covered department; J. L. Adams, superintendent of lead-covered department, and a staff of eight or ten salesmen.

The Chicago Pneumatic Tool Company, Chicago, Ill., exhibited a very complete line of the "Little Giant" storage batteries and the "Duntley" air-cooled electric drills. These air-cooled drills were shown in various sizes, and demonstrations were given of the adaptability of this apparatus to both light and heavy work. A novel feature of the exhibit was a portable electric drill for drilling a three-eighths-inch hole in either steel or iron, which was run from a battery outfit of ten cells, the motor being wound for twenty volts. Another novelty exhibited by the company



THE MADISON SQUARE GARDEN ELECTRICAL SHOW, NEW YORK CITY, DECEMBER 12-23, 1905.



THE MADISON SQUARE GARDEN ELECTRICAL SHOW, NEW YORK CITY, DECEMBER 12-23, 1905.

was an electrically driven cloth cutter. This is designed so that after a bundle of cloth is marked the tool is laid upon the top surface and guided along the outlines, cutting the cloth through as fast as the workman can direct it along the line. The company was represented by T. A. Aldcorn, general sales agent; C. B. Coates, electrical engineer; A. B. Innes and W. J. Blake.

The Simplex Electric Heating Company, Cambridgeport, Mass., was represented by its New York agent, Roger Williams. The exhibit at this booth was particularly attractive, and was always one of the centres of interest. Mr. Williams hit upon the happy idea of specializing in the distribution of dainties each night, and also made a hit by distributing hot coffee and electrically cooked food of various descriptions to the attendants at the various booths throughout the Garden.

The exhibit of the Gray National Telautograph Company, New York city, was patronized by many visitors, who took away the transcribed messages as souvenirs. The company was represented by Mr. Robert P. Parrott.

The National Battery Company, Buffalo, N. Y., showed a line of automobile batteries, telephone and telegraph batteries, and, in addition to a number of photographs, showing typical illustrations, there were several cabinets showing in detail the assembly of the various forms of storage battery. This exhibit was presided over by Mr. James M. De Mallie, sales engineer for the eastern district.

The Clark Electric and Manufacturing Company, New York city, exhibited a line of insulating material. This included copper splicing sleeves for splicing hard-drawn copper wires and cables, interlocking insulator clamps, underlocking insulator clamps, angle-locking insulator clamps and Ball-socket insulator clamps. The company also exhibited for the Ansonia Brass and Copper Company a special hemp-centre stranded copper conductor for high-tension work. This conductor has a very high elastic limit, and very great tensile strength. Mr. Harry A. Wilson and Mr. P. J. White represented the company.

The Kinsman Block Signal System Company, New York city, showed a complete outfit for operating an electrical stop system on a moving locomotive or train. This system is a combination of devices for preventing a train from entering a danger zone by automatically shutting off the steam or electricity, applying the air-brakes when, for any reason, the visual signals have been misunderstood or disobeyed. The company was

The Sarco Company, New York city, represented by Frank E. Kinsman, G. Colby, A. J. Lowndes, J. B. Collins, C. H. Kinsman and W. F. Messenmoscher. was represented by R. A. Schoenberg and W. L. Auerbacher. The new quick-break, quick-make pendant switch manufactured by this company was used on all of the cluster lighting and on the various fixtures throughout the exhibition. The new Sarco light—a flaming arc light recently imported by the company—was on exhibition, and this attracted a great deal of attention.

The National Meter Company, New York city, exhibited a "Nash" three-cylinder gas engine, driving a thirty-kilowatt C & C dynamo. This unit was in constant operation supplying current for several large electrical signs which were mounted above the company's booth. The company was represented by J. C. Kelley and F. C. King.

Mr. Rudolf Miehling represented the Charles A. Thompson Company, New York city. This company had a very attractive joint exhibit with the St. Marys Incandescent Lamp Company, St. Marys, Pa., and the Sun Porcelain Company, Trenton, N. J., McLeod, Ward & Company, New York. At this booth were W. T. MacDowell, representing "Solderine" and "Navalite" conduit, and Robert Mulligan.

The Eastern Carbon Works, Jersey City, N. J., exhibited a very complete line of carbon products, dry batteries, flash lights, gas lighters and novelties. This company was represented by William Mills, and O. L. Turgeon.

The George L. Mason Company, New York city, exhibited the Mason jeweled sign, the letters being made up in innumerable combinations.

The General Storage Battery Company, New York city, exhibited the "Bijur" high-duty storage battery. The exhibit included a charging booster, a standard battery case for railway signals, a constant-current booster, a main switchboard, a yacht-type switchboard, a yacht-lighting battery, a table of exhibits of high-duty plates, a switchboard and cells of various sizes. Mr. Joseph Bijur was in attendance, supported by a number of representatives.

The New York Telephone Company had one of the handsomest booths in the Garden, and this was patronized at all times by the visitors, this apparatus having become one of the most familiar adaptations of electricity at the present time. All around the Garden there were many elaborate exhibits, each one of which had some special feature of attraction for many interested visitors. The general view is given very well in two of the illustrations presented herewith.

Among other exhibitors were the following: American De Forest Wireless Telegraph Company, New York city; Victor Talking Machine Company, Camden, N. J.; Gold Car Heating and Lighting Company, New York city; Van Dyck-Churchill Company, New York city; Bender-Martin Company, New York city; the Wireless Electric Company, Philadelphia, Pa.; Brunswick Refrigerating Company, New Brunswick, N. J.; Prometheus Electric Company, New York city; Natural Food Company, Niagara Falls, N. Y.; Stow Manufacturing Company, Binghamton, N. Y.; Enos Company, New York city; Niagara Tachometer and Instrument Company, Buffalo, N. Y.; Peerless Electric Company, Warren, Ohio; Magnet Wire Company, New York city; International Text Book Company, Scranton, Pa.; Tacony Iron Company, Philadelphia, Pa.; Electro-Radiation Company, Boston, Mass.; Charles E. Dressler & Brother, New York city; Webb Self-Lighting Company, New York city; Magneta Company, New York city; G. M. Gest, New York city; Dossert & Company, New York city; Safety Electric Elevator Company, New York city; American Telegraphone Company, New York city; Holcombe & Company, New York city; Caldwell & Osterhoudt, New York city; Standard Vitrified Conduit Company, New York city; International Optical Company, New York city; Waite & Bartlett Manufacturing Company, New York city; National Carbon Company, Cleveland, Ohio; Elmer P. Morris, New York city; Cooper Hewitt Electric Company, New York city.

Each afternoon and evening there were band concerts given by Daquin's military band.

Mr. Earle L. Ovington delivered a series of lectures, supplemented by practical demonstrations of spectacular electrical experiments on special apparatus. These experiments covered the phenomena of high-tension discharges, high-frequency currents, electrotherapeutics, wireless telegraphy, Rœntgen rays and some Tesla demonstrations. These exhibitions were open to the public.

Through the courtesy of the street cleaning department of the city of New York, a very complete model was shown of the incinerating plant established at one of the docks, which is used for loading the sea-dumping scows for getting rid of the refuse of the city of New York.

Instructions for Resuscitation from Electric Shock.

Under the auspices of the Hudson River Electric Power Company, there were recently gathered at the office of Dr. D. L. Kathon, on Union street in Schenectady, N. Y., a number of the heads of departments of the Hudson River Electric Power Company and its allied and auxiliary companies at Mechanicsville, Spier's Falls, Utica, Scoharie and Watervliet. The meeting was arranged by Brice E. Morrow, manager of the Electric Power Company. Dr. Kathon delivered an interesting lecture on the best and most modern methods of resuscitating a person who had received an electric shock, and also illustrated the treatment of persons suffering from electrical burns. The lecture was illustrated with a living subject. It is proposed to have similar lectures in the future, every precaution being taken to ensure the safety of those employed by the several companies.

Electrification of the Pennsylvania Railroad.

Up to the present time the principal advance in the electrification of steam roads has taken place at the terminal stations or upon branch roads, so that the recent decision of the Pennsylvania Railroad to equip electrically a portion of its system between Camden and Atlantic City, N. J., is of the greatest interest. The developments which have taken place at New York, under the direction of the New York Central & Hudson River Railroad and New York, New Haven & Hartford Railroad companies, have focused the attention of the engineering world on this branch of railroad engineering, and this further advance of electric traction, coming as it does when this phase of railroading is fresh in the minds of all engineers, marks another milestone passed in the substitution of electricity for steam for railway service.

That portion of the Pennsylvania railroad to be electrified comprises some sixty-four miles of steam road lying between Camden and Atlantic City, N. J., being a portion of the West Jersey & Seashore branch of the Pennsylvania system. It is proposed to utilize the Cape May line of this system from Camden as far as Newfield, this line being double-tracked with 100-pound rails, and to build an additional track from Newfield to Atlantic City, making the lines double-track throughout.

Over this roadbed an express service will be established. The initial installation will provide for a three-car train every fifteen minutes between Camden and Atlantic City, making the sixty-four miles in eighty minutes without stops. The maximum speed of the cars will be between fifty-five and sixty miles per hour.

In addition to this through service to Atlantic City, a half hourly schedule is planned, consisting of two-car trains between Camden and Millville, forty miles, and ten-minute service of single cars between Camden and Woodbury, eight and one-half miles. Full service will call for fifty-eight cars in operation, each equipped with two 200-horse-power direct-current motors known as GE-69. These motors will be similar to those now being manufactured by the General Electric Company for the equipments of the New York terminal of the New York Central & Hudson River Railroad. The motors will be controlled by the Sprague-General Electric automatic multiple-unit system, which will permit the operation of cars in trains, all of the motors being under the control of the motorman in the cab of the forward car.

Current will be furnished to the cars by the third-rail system, except on the sections between Camden and Woodbury, and Newfield and Millville, where the cars will obtain the necessary current by an overhead trolley. The speed on these sections is less than on the main line.

At Camden the power-house will be located. Power for the operation of the cars will be furnished by three 2,000-kilowatt General Electric-Curtis turbo-generators of the three-phase alternating-current type, having a frequency of twenty-five cycles. From this power-house transmission lines will be run to six substations between Camden and Atlantic City, and a seventh substation at Millville to supply that section of the road lying between Millville and Newfield.

The transmitting potential will be 33,000 volts. At the substation a total capacity of 11,000 kilowatts in rotary converters will be provided, delivering direct current to the third rail at 650 volts. The individual units will be of the standard General Electric type and will have a capacity of 750 kilowatts. They will be started from the alternating-current end by means of taps on the stepdown transformers.

The contract calls for the completion of this road by July 1, 1906, in order to take care of the heavy summer traffic. The total amount of money involved is about $3,000,000. The electrical equipment will be furnished by the General Electric Company.

The Hydroelectric Power Plant of the Nevada Power, Mining and Milling Company.

The hydroelectric power plant of the Nevada Power, Mining and Milling Company is situated on the Bishop creek, Inyo county, Cal., about seven miles from the town of Bishop. The transmission line extends to Goldfield and Tonopah, in Nevada. The first generator was placed in operation about the twentieth of last September, and since then power has been regularly delivered to the above places. The company owns the local light and power companies of the two cities, and thus a portion of the load is taken by the lighting circuits, and the remainder is used in the stamp mills and mines. Bishop creek lies on the eastern slope of the Sierra, and, with the exception of the Owens river, is the only considerable stream on that side of the mountains for several hundred miles. Its head waters are in the snows of the highest part of the Sierra Nevada, which here reaches an altitude of over 14,000 feet above sea level. The plain of Bishop or the Owens river valley lies at an elevation of 4,000 feet. The mountains rise abruptly from the plain, and the descent of the stream is correspondingly rapid. Its fall is over 1,000 feet in two miles, and is thus thought to offer the most favorable location of any power plant in the West. The water is taken from the creek by a small diverting dam, and conveyed along the mountain side in a wooden stave pipe until it reaches a point above the power-house, where it enters the steel pipe that leads to the power-house on the creek bank. The transmission line extends across the valley of the Owens river, then over the White mountains, and across the Nevada deserts to Tonopah Junction—eighty-five miles. From there the line branches to Tonopah, eighteen miles, and to Goldfield, ten miles, making the total length of line 113 miles. In crossing the White mountains the line reaches an elevation of over 10,500 feet. The pipe line is about 12,000 feet long, consisting of 6,700 feet of forty-two-inch wood stave pipe, 2,150 feet of thirty-inch wood stave pipe, and 3,150 feet of twenty-four-inch steel pipe. The forty-two-inch pipe runs on a nearly level grade, the static head at the lower end being about thirty feet. At this point are placed two gate valves—one for the present thirty-inch pipe, and the other providing for a future line. The thirty-inch pipe descends the hill to a point that gives a static head of 265 feet. Here it joins the twenty-four-inch steel pipe which descends to the power-house, the total static head being 1,068 feet. The water-wheels are of the Pelton type. Two are direct-connected to two 750-kilowatt, sixty-cycle, 2,200-volt, three-phase alternators, running at 450 revolutions per minute. There are, in addition, two exciters driven by small wheels. The current from the generators is transformed up by means of 500-kilowatt oil-insulated and water-cooled transformers to 30,000 volts. From the power-house to Tonopah the line is of stranded aluminum equivalent to No. 0. From Tonopah Junction to Goldfield the line is of No. 2 aluminum, stranded. The insulators are fourteen-inch, four-part porcelain, held on malleable iron pins. The triangle is seventy-two inches on a side, and spans normally 310 feet. The lower two pins are carried on a cross-arm six feet eight inches long; while the upper pin is carried on an eight-inch channel iron extension bent to U-shape, and bolted to the top of the pole. The company's telephone line is carried on a separate pole line located at some distance from the power line. A switch station was built at Tonopah Junction, and substations at Tonopah and Goldfield. The latter two contain each three oil-insulated, air-cooled transformers rated at 300 kilowatts, reducing the pressure to 6,600 volts for local distribution.—*Journal of Electricity, Power and Gas (San Francisco), December.*

Reviews of Current Engineering and Scientific Literature.

The Graphic Calculation of Dynamo Shunt Rheostats.

A quick and convenient method of selecting a suitable shunt resistance for a dynamo is here described. All that is required is the usual saturation curve of the generator. This should preferably be carefully taken, but if approximate results only are needed, an approximation of this characteristic will suffice. The curve is plotted as usual, with the ordinates in volts and the abscissæ as amperes of excitation. From that point on this characteristic representing normal conditions of operation, a line is drawn horizontally backward toward the pressure axis. If, then, a line be drawn from any point of this horizontal line to the origin, it will cut the saturation curve at some point. The voltage at this point will be that given by the generator, under suitable conditions, when the resistance of the rheostat bears to that of the field the same proportion as the parts of the horizontal line—that is to say, if the point selected is one-third of the distance from the end of the saturation curve toward the vertical axis, then a shunt rheostat having a resistance one-half that of the field current will give, when introduced entirely into the field circuit, a stable voltage equal to that where the line drawn from the point of division to the origin cuts the saturation curve. There is another way of obtaining the same result: that is, by computing from the saturation curve a second curve of ampere ohms, which shows the total resistance in the shunt circuit corresponding to any point on the saturation curve. But as the results obtained by the two methods are identical, the graphic one is to be preferred, since it is the simpler. This graphic method may be used also for the determination of the compounding of dynamos for desired characteristics.—*Abstracted from the Electrical Review (London), December* 1.

A Dynamometric Brake.

M. A. Krebs here describes the use of a dynamo as an absorption dynamometer when adjusted so as to enable the torque delivered to it to be measured. The method of doing this is a modification of the cradle-dynamometer. The interest here lies chiefly in the use of the apparatus in practice, and for widely varying power measurements. The dynamo which is used as the absorption dynamometer is mounted so that the field is free to turn on ball bearings. Scale beams are bolted to it, by means of which sliding weights allow the resisting torque to be measured. The power delivered by the machine is used for the ordinary work of the shop, and there is, therefore, no waste energy. The advantages claimed for this dynamometer over the ordinary Prony brake are: the complete control of the output of the machine; there is no waste of energy, and the test may be carried on as long as desired without involving any of the ordinary inconveniences of the brake; the speed of operation can be varied at will, and the power lost in making a test is not more than ten to fifteen per cent of that delivered by the machine tested. M. Krebs says that he has used this arrangement for speeds varying from 500 to 2,500 revolutions per minute, and for powers varying from one horse-power to 200 horse-power. On one occasion, when the motor to be tested was large, two of these dynamometers were attached to it, one being coupled to each end of the shaft. It has been in use for some years past in the shops of the Panhard & Levassor Company, of Paris.—*Translated and abstracted from L'Électricien (Paris), December* 2.

The Use of a Magnetic Field with the Ryan Cathode Ray Oscillograph.

One of the inconveniences of the cathode ray oscillograph, as developed by Professor H. J. Ryan, is that, with extended use, the tube vacuum, and consequently the necessary operating voltage, increase rapidly, causing a leakage from terminal to terminal inside the tube. Several means of reducing the vacuum have been tried. The one considered here consists in placing around the neck of the tube, between the cathode and the aluminum diaphragm, which cuts off all but a small bundle of rays, a field coil which sets up a magnetic field parallel to the path of the ray. The behavior of this coil seems at first somewhat irregular, as the reduction in voltage does not vary directly with the intensity of the current in the coil. It was found that the decrease in voltage was slight until the intensity of the magnetic field was sufficient to prevent the rays from impinging upon the walls of the tube, and to direct them more nearly toward the centre of the diaphragm. To be effective the coil must be placed between the diaphragm and the cathode, and, under favorable conditions, it may decrease the voltage required to establish the cathode ray to one-tenth that taken when the coil is absent. The following conclusions are given: a magnetic field parallel to the path of cathode rays does not alter the amount of current taken by the ray over the wide range of voltage obtainable with such a field; but a large, though irregular, decrease in the voltage required to produce discharge in a cathode-ray tube accompanies a strong magnetic field parallel to the direction of the rays. The direction of the parallel field has no effect upon the results. It has been found possible to obtain good results by using a fairly low number of ampere-turns placed close to the anode. In this position the coil does not affect the shape of the card on the screen, while it secures a well-defined spot without the troublesome flickering due to high voltages, giving, at the same time, a more intense spot of light by directing more rays through the aperture in the diaphragm, and it enables the sensitiveness of the oscillograph to be varied by giving some control over the velocity of the rays.—*Abstracted from the Physical Review (Lancaster), November.*

The Belfast (Ireland) City Tramways.

The tramways of Belfast, Ireland, became the property of the city on January 1, 1905. The total amount that has been paid to acquire the property, to release the unexpired loss, compensation to officers, etc., and for the new work, amounts to nearly $5,000,000. The total length of the system is nearly forty miles of double track. The conversion of the system to electricity is nearly completed, and a number of the routes were opened to the public on November 30. The new generating station of the plant forms an extension to the city supply works which were erected in 1888. The site is close to the river Lagan, in the southwest part of the city, and about a mile from the centre. The generators are compound-wound, and supply current at 550 volts for the railway system, or run as simple shunt machines at 440 volts for three-wire distribution. The original plant consisted of a 200-kilowatt generator, and two fifty-kilowatt balancing sets, to which additional sets had been added so as to

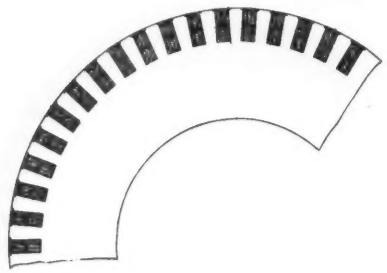
bring the total equipment of the station up to 3,400 kilowatts. The new plant has been equipped with a complete coal-handling plant, which takes the coal from the barges on the river and delivers it to the bunkers over the boiler room. In the boiler room the boilers have been arranged in a single row in sets of two. Each boiler is provided with its own economizer. They are of the Babcock & Wilcox type, fitted with superheaters for raising the temperature of the steam 150 degrees Fahrenheit. The engine-room equipment consists of three 1,000-kilowatt, continuous-current generators, direct-connected to vertical, three-crank, triple-expansion engines. The generators are of the Westinghouse make, have sixteen poles, are wound for a constant voltage of 550, when connected compound. The water for the condensing plant is circulated by three Gwynne electrically driven centrifugal pumps, arranged in a pump house on the river bank. Two twelve-inch pumps are each directly coupled to a thirty-brake-horse-power motor, and will deliver 150,000 gallons of water per hour. A fifteen-inch pump is coupled to a fifty-horse-power motor, and will deliver 300,000 gallons of water per hour. The height of the lift varies considerably with the state of the tide, but the maximum lift is not greater than fifteen feet. From the main generating station energy is distributed to the line and to a substation at the Fort William depot, for operating the portion of the system in that district. At this place there are two 150-kilowatt, three-phase, synchronous motor-generators, which draw their power from two 250-kilowatt synchronous motor-generators at the power-house. The latter machines are supplied with continuous current, either from the traction or the lighting switchboards, at a pressure of 500 to 550 volts. They generate three-phase current direct at 6,000 volts, fifty cycles, at which pressure it is transmitted over the line. The two machines at the substation are each provided with a small three-phase induction starting motor, mounted on the same shaft. The overhead equipment is mainly of span-wire construction, though there are two stretches of side-bracket work. Centre poles, where used, are lighted by means of two incandescent lamps, mainly for the purpose of locating the pole. The underground feeders are of Callender's bitumen insulated type, laid in troughs run in solid with bitumen. The troughs are covered with hard-burned tiles. Two cables are laid in each trough, the arrangement throughout being that the feeders, together with the telephone and test wire for the same route, are placed in the same troughs. There are sixteen line-feeders and four return feeders. The length of the feeders varies from 1,500 yards to 7,500 yards, and the section, from one square inch to 0.15 square inch. The section of the rail-return feeders varies from two and one-half square inches to one and one-half square inches. The present equipment consists of 170 cars of the double-deck, single-truck type, each with accommodations for fifty-four passengers. There are, in addition, fifty horse-cars undergoing conversion for use on the new system.—*Abstracted from the Electrician (London), December 1.*

Electrolytic Copper.

Mr. Lawrence Addicks discusses here the electrolytic refining of copper, especially from the point of view of the multiple system. He first calls attention to the opinion, still held in many quarters, that Lake copper is superior to all other grades. For almost all purposes, however, there should be no hesitation to-day in specifying electrolytic copper. In conductivity and in mechanical properties it leaves little to be desired. Any advantages which it is thought the Lake copper has for mechanical working must be attributed to its impurities. A small quantity of arsenic, for example, while exceedingly detrimental to the conductivity, will improve appreciably the mechanical properties of copper. At one time arsenic was considered necessary in English specifications for fire-box copper. Each year, however, a greater proportion of the world's output is refined electrolytically, and it seems probable that before long there will be but two grades of copper on the market: high-conductivity copper, which will include electrolytic and picked brands of Lake; and casting copper, covering all material which will not pass a conductivity requirement of ninety-eight per cent annealed. Mr. Addicks then takes up the refining process. The ideal electrolyte would be one chemically inert as a solvent, but capable of dissolving electrochemically copper, and having zero specific resistance. These conditions are most nearly met by an acidulated sulphate solution, and this has the additional commercial advantage of employing one of the cheapest of chemicals—sulphuric acid. In the refining operation the soluble sulphates go into solution and grow cumulatively. Selenium and tellurium and the precious metals go entirely into the slimes. There is therefore a triple separation. The usual products are only copper at the cathode, silver and gold from the slimes, and sometimes copper and nickel sulphates from the electrolyte. Selenium and tellurium are easily recoverable from the slimes, were there sufficient market. Tellurium is an element almost without use in the arts, though small amounts are used in medicine. Arsenic is the most difficult impurity with which to deal. The cathode copper is exceedingly pure, usually running about 99.93 per cent copper; hydrogen is the chief impurity. The objectionable cathode impurities are of two classes—those which depress the electrical conductivity, and those which make the metal brittle. Arsenic and antimony represent the first class; tellurium and lead, the second. Good cathode copper should show but a few thousandths per cent of arsenic and antimony. Any conductivity troubles in electrolytic copper can almost invariably be traced to the presence of undue amounts of one or both of these elements. Impurities of the brittle-making type are rarely met with, and, if present, are due to mechanical contamination of the cathode. The resistance of the circuit is made up approximately as follows: fifteen per cent metallic resistance; sixty per cent electrolyte, including the transfer resistance, which seems to be due to a sort of polarization at the electrodes; twenty per cent, due to poor contacts; and five per cent, due to counter-electromotive force of the cell. The contact resistances vary enormously, depending upon the cleanness of the surfaces and the pressure applied. The size of tank is chiefly a matter of construction. The number of electrodes placed in parallel does not seem to bear any direct relation to the current efficiency. Various dopes have been tried for controlling the character of deposit. Ammonium sulphate undoubtedly exerts a beneficial effect in encouraging smooth deposits. Organic reducing agents, notably gelatine, have a restraining effect upon the crystalline nature of deposits, but these are not easily controlled. Comparatively little copper is put upon the market in cathode form, although this is an ideal shape from which to make brass and copper castings. The wire bars and ingots never give a conductivity equal to that shown by samples from the methods from which they are made. This is partly due to the absorption of some impurities from the furnace lining.—*Abstracted from the Journal of the Franklin Institute (Philadelphia), December.*

Electrical Patents.

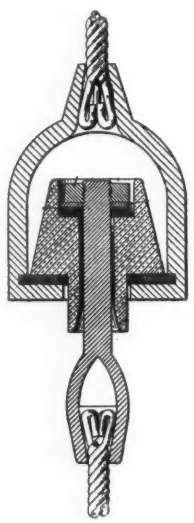
An armature for electrical machines has been invented by Wm. T. Hensley, of Bound Brook, N. J. (805,547, November 28). The invention, which affords a satisfactory means of ventilating the armature core, consists of armature discs, having teeth between which the armature coils are arranged, with spacing-pieces arranged along the coils and having shoulders engaging the teeth, the shoulders being of



Armature for Electrical Machines.

less width than the teeth on the disc and forming ventilating spaces between the spacing-pieces.

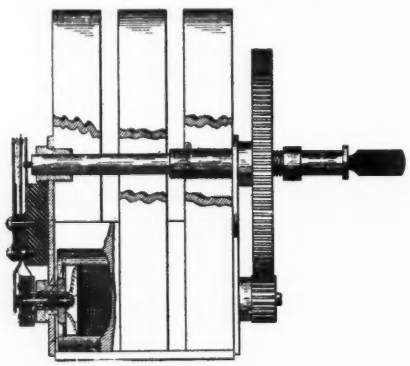
Samuel L. Foster, San Francisco, Cal., has invented an electric strain insulator used with guy or supporting wires, cables or electrical conductors, to separate electrically the part of the wire, cable or conductor on one side of the insulator from the part of the wire, cable or conductor on the other side of the insulator (805,778,



Electric Strain Insulator.

November 28). The objects of the invention are: to provide a more durable insulating substance under compression than has formerly been used; to dispose this insulation in a more visible and accessible position and to arrange it so that it can readily be replaced or renewed; to construct the insulation so as to reduce to a minimum the tendency to deterioration in the conductors when attached to it; and to construct the insulator so as to reduce to a minimum the labor cost for attaching the guy or supporting cables or electrical conductors to the insulator. The invention comprises the combination of an open link-like metallic body having a flat and centrally perforated base; a bolt passing into said body through its perforated base and insulated therefrom; a nut on the inner end of the bolt, and an apertured insulating block under compression between the nut and the flat base of the body, said block having a tapering wall terminating in an enlarged flat base.

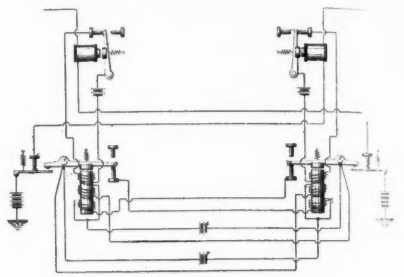
William Kaisling, Chicago, Ill., has invented an electric-current generator, and assigned the patent to the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. (805,557, November 28). The invention relates particularly to magneto-generators employed in the telephone art, its object being to provide improved switching mechanism so that various con-



Magneto Generator.

nections may readily be made with the armature of the generator to supply various kinds of currents. The invention is of great importance in party-line telephone systems where, for instance, alternating currents, pulsating currents, and direct currents are required for operating substation selective apparatus. The invention provides improved switching mechanism attachable to any generator and provided with terminals which offer various combinations. By connecting with two of the terminals alternating current will be received from the generator; and by connecting with another set of terminals direct current will be delivered, and two other sets respectively furnish pulsating positive current and pulsating negative current.

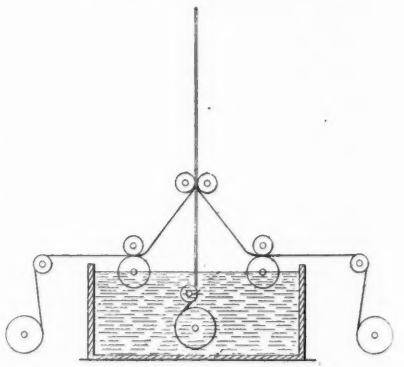
Francis W. Jones, New York, N. Y., has obtained a patent (806,412, December 5) for an improved telegraph repeater. This invention relates to automatic apparatus for interchangeably repeating current variations from one circuit to another. The object of the invention is to increase the certainty of operation of such repeaters, to reduce the expense of the instruments, and to employ only common and well-known instruments, readily modified to adapt them to such use. The apparatus employed on each circuit consists of an ordinary relay and an



Telegraph Repeater.

electromagnetic transmitter operated by the relay. The transmitter has three coils on its single magnet. This magnet is preferably a horseshoe magnet. One coil is in a permanently closed local circuit. Another coil is in a local circuit controlled by the repeating points of the relay, and the third coil is in a local circuit operated by the down contact points of the opposite transmitter. Two of these coils affect the magnet in the same sense or direction. One coil is differential or opposed to the other two coils. The effect of the differential coil is substantially equal in its magnetizing power to either one of the other two coils, but not to both.

An improvement in insulating electric conductors has been invented by Isidor Kitsee, Philadelphia, Pa. (806,348, December 5). The invention relates to an improvement in insulating electric conductors and the necessary process. The object of the invention is to produce economically an insulating covering for wires. The invention consists in the process of insulating electric conductors with an



Insulating Electric Conductors.

amorphous-cellulose compound which consists in first carrying the wire to be insulated through means adapted to moisten the wire with a solvent of the amorphous-cellulose and then carrying the wire and a strip or strips of cellulose through compressing means, thereby enclosing the wire in a strip or in strips and making the wire adherent to the strips.

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

The accompanying illustration is a reproduction of an advertisement four and one-quarter inches by eight and one-half inches which recently appeared in some of the New York dailies. The New York Edison Company has been keen to make a bid for holiday business, and at the same time to advocate the use of electric heating and cooking apparatus. The very deep interest shown by the host of visitors to the Madison Square Garden electrical show, during the past two weeks,

ELECTRIC HEATING and COOKING
ELECTRIC heating of large areas is not as yet commercially practicable. But for taking the chill off small rooms, for foot warmers and a merely incidental service it fulfils every expectation
For cooking or laundry service, no electric device is now lacking. Fully a hundred are on the market. They include chafing dishes of every design; French coffee pots; waffle irons; hair curlers; shaving cups; portable stoves of all sizes; the heating pad, superseding hot water; smoothing irons from the one patite for handkerchiefs to the great tailor's goose; plate warmers; doctors' and barbers' sterilizers. The list is too long to be fully given here
Most of these devices take the place of the ordinary incandescent lamp in the socket, and their use costs an insignificant sum. A chafing dish can be used for 15 minutes for 1½ cents. Dangerous alcohol is abolished, and the Edison current costs less
Electric Lighting Outfits for Trimming Christmas Trees
Safe, clean, convenient, inexpensive
Sold by the electrical supply houses and contractors and the principal stores
The NEW YORK EDISON CO
55 DUANE STREET Tel. 1930 Franklin
200 Grand Street 117 West 125th Street
30 West 32d Street 434 East 149th St. and 3d Ave

in every form of electric heating and cooking device, plainly indicates that there is a fertile field ready to be opened up for this material. This condition of affairs in Greater New York must surely be similar to that which exists in every city, large or small. The almost universal complaint on the part of the interested party is that there is no facility in the house for using electric current. The fact that electricity is an elegant and convenient form of illumination is not sufficient, in many cases, to cause a householder to go to the expense of wiring. The added advantages of electrical cooking and heating, however, are presenting one of the strongest arguments which the central station advocate has to offer. The electrically heated laundry iron is a peculiarly attractive proposition, and it would seem wise to make a decided stand on this article at least.

The newspaper advertising of the New York Edison Company has been well placed and the readers have received many suggestions. The style of display is uniform and particularly attractive. The plates are made by the Edison company and delivered to the newspapers in order to avoid an unsymmetrical arrangement of the series.

The Edison Electric Illuminating Company, of Brooklyn, N. Y., has inaugurated an innovation in the relations between the employés of a corporation and those more directly responsible for the conduct of its business. On the evening of Wednesday, December 13, nearly 1,200 employés of the Edison company, and their women folk, were invited to a reception by the officers and staff council. The entertainment included a splendid performance by Miller's orchestra, many selections by the Victor talking machine, and selections on the electric piano. In addition to this there was an electric cooking and heating display, with Mr. Max Loewenthal in charge, and Miss Helen Tovell as demonstrator. The other features included a Christmas-tree illumination, a display of Cooper Hewitt lamps and working exhibits of electric sewing machines, massage outfits, the Gray writing telautograph, a wireless telegraph outfit, a large electromagnet, Poulsen's speech-recording telegraphone, an "Autarith" calculating machine and many modern office appliances, such as addressographs, adding machines and business phonographs. The applications of the various forms of meter were also displayed. During the evening a collation was served, and it is safe to say that nothing has prompted so much good will between the employés, who, in fact, represent the general public, and the Edison company in recent years.

In answer to an enquiry recently addressed to the Kansas City, Mo., Electric Light Company, regarding its methods of publicity, Mr. R. E. Richardson, the general manager, forwarded a brief outline of the work of the company in this department. The company has the city divided into districts, in each of which a solicitor is placed and held responsible for the success of work in that territory. These solicitors carefully watch the erection of all new buildings from the foundation up. They visit the owner, and ascertain whether or not it is the intention to wire the building. If not, pressure and such argument as is necessary are brought to bear to induce the owner to wire the property. Success invariably crowns these efforts. In the interim, when new business slackens, the solicitors make a house-to-house canvass of old houses in their respective territories for the purpose of inducing the owners or tenants to wire them and use electricity for lighting purposes.

The company pays little or no attention to newspaper advertising, preferring the present solicitation plan of campaign. Illustrated booklets are not made use of, except on rare occasions, and then only for special advertising of some electric novelty or specialty. These are mailed direct from the company's office to prospective consumers. The company does not undertake interior wiring of any nature. If a prospective customer wishes a house wired, the company takes up the matter for him, and refers him to one or more of the many construction houses in the city.

In all lamp renewals, the invariable rule of the company is to require a deposit of twenty-five cents upon each lamp furnished consumers. When a consumer discontinues his service, he is refunded twenty-five cents for each unbroken lamp returned to the company's lamp room. When given a renewal, he is required to bring the dead lamp with him and turn it in to the company.

The company handles its bureau of information and complaints through the consumers' department. There is always a member of this department on duty to take care of these matters.

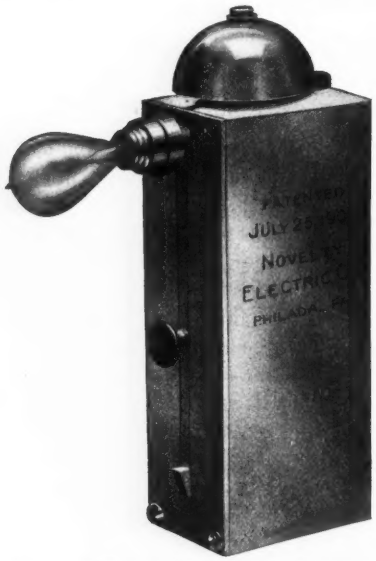
Only in special instances are advertising letters used, the company depending upon special representation and personal contact for making friends and creating new business.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Electrical Nurse Signal and Recorder.

The accompanying illustrations show a new form of electrical nurse signal and recorder for use in hospitals, manufactured by the Novelty Electric Company



ELECTRICAL NURSE SIGNAL AND RECORDER.

Philadelphia, Pa. This system was originally used in the new Germantown Hospital, Germantown, Philadelphia, Pa.,

ELECTRICAL NURSE SIGNAL AND RECORDER—DISPLAYING SIGNAL.

and has been designed to provide a reliable signal system which will be quiet in action, and at the same time effective, ensuring immediate attention on the part of attendants, as well as avoiding any annoyance and disturbance to the patients, occasioned by the incessant ringing of an electric-call bell.

In this system a single pressure of an electric button suspended from the wall by a flexible conductor, within easy reach of a patient, results in four signals being given. These signals take place as follows: a single tap on a low-toned bell on the top of the box, each box being placed at one entrance to the patient's room; the dropping of an arrow, which, when down, extends beyond the line of the wall or corridor, and is easily seen by any one passing, indicating that an attendant is wanted. An annunciator is also set in the nurses' room and in the room of the

THE MECHANICAL ARRANGEMENT OF THE SIGNAL RECORDER.

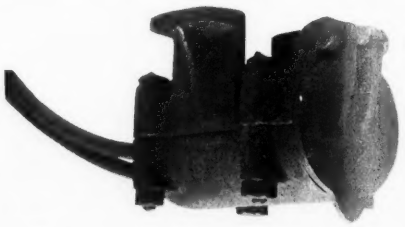
superintendent, giving the number of the room from which the signal has been sent. This latter signal in the superintendent's room simply acts as a check upon the promptness with which the call is answered, all signals remaining set until the nurse or attendant, upon entering the room, raises the arm and restores it to normal position, ready for the next call.

At night, when the drop arrow might not be readily distinguished, a small incandescent lamp in circuit with the lighting system lights up when a call is made, and is extinguished when the arrow is raised to a normal position. During the day the current supply of the lamp is switched off.

The mechanical arrangement is simple and has no complicated parts. The pressure of the button actuates an electromagnet, which attracts an armature, releasing the arrow, which falls by gravity, closing the circuit through a local battery, connecting the dials and annunciators. When the arrow is raised the circuit is broken and the annunciators immediately reset.

Westinghouse Charging Receptacle.

The extensive use of electrically operated vehicles and the varied application of storage batteries for train lighting, small electric locomotives, storage battery cars,

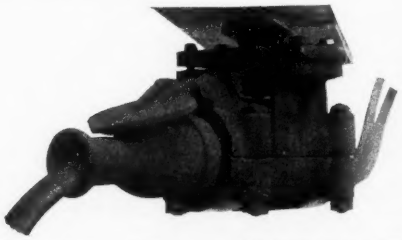


WESTINGHOUSE CHARGING RECEPTACLE.

etc., has created a demand for convenient and durable accessories, one of the most important being a charging receptacle that will withstand hard usage and can be handled without danger of short-circuiting the line when inserting or removing the plug.

With this idea in mind, the Westinghouse Electric and Manufacturing Company has developed and placed upon the market a charging receptacle that will meet the most rigid requirements.

It consists of a cast metal case, circular in form, that occupies a minimum amount



WESTINGHOUSE CHARGING RECEPTACLE WITH SWIVEL ATTACHMENT.

of space. Within the case are suitably mounted contacts for receiving the plug. A hinged lid at one end, held normally closed by a coiled spring, affords access to the interior. The receptacle being entirely enclosed effectually protects it from dirt and water.

The plug and contacts within the receptacle are so designed that it is impossible

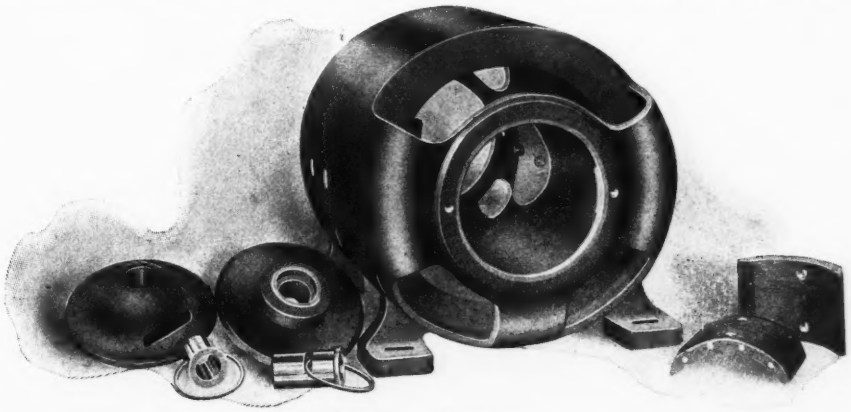
to cause a short-circuit when inserting or withdrawing the plug.

The receptacle may be provided with a swivel attachment, conforming to standard railway practice, which is a decided advantage as it admits the pulling out of the plug when the vehicle or car starts, the receptacle swinging in line with the cable, and allowing the plug to pull out without danger of breaking the cables or contacts.

The charging plug shown in the accompanying illustration is intended for use with the charging receptacle. It is furnished with or without cables, as desired. The construction is rugged and all parts are well made, ensuring a long period of service.

Small Direct-Current Motors and Generators.

The Sterling Electric Motor Company, Dayton, Ohio, has placed on the market a new line of small direct-current motors and generators. The theoretical design has been carried out with a view of providing for a high efficiency, low temperature in the electrically active parts, and for satisfactory commutation at all conditions of load. The mechanical design has also been given the closest attention, and no detail has been slighted.

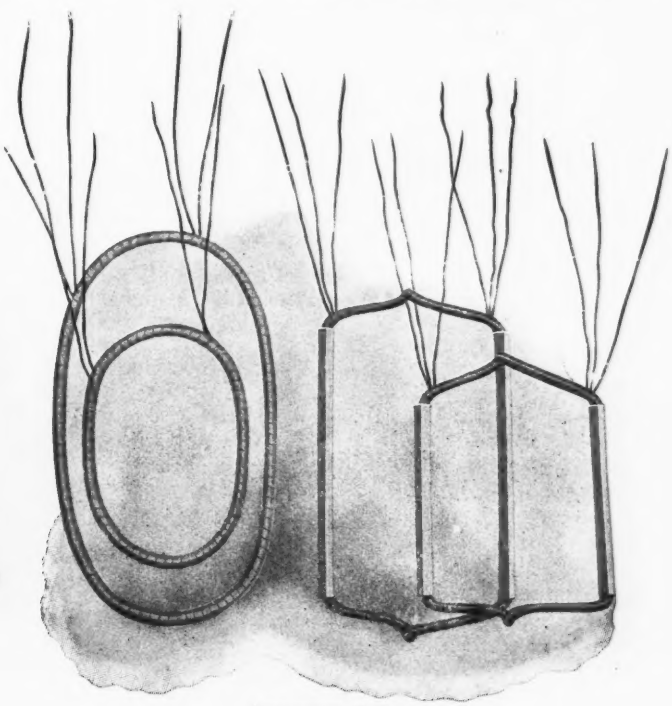


FRAME AND FITTINGS.

The frame is made of soft cast iron of a high permeability, and is uniform and true to pattern. The magnet cores are of solid steel cast-welded into the frames, and provided with laminated pole-shoes securely bolted to the magnet core. The frames are built with two poles for the smaller sizes up to and including two horse-power, and with four poles on sizes from three horse-power and upward. A liberal allowance of material has been made, resulting in a sturdy construction with a strong magnetic flux. The outline of the motor frame is rounded off, avoiding sharp corners and offering a large heat-radiating surface. By the use of laminated pole-shoes, a uniform field is obtained at the pole corners. The eddy current losses in the pole-face, the manufacturer claims, are considerably reduced, which increases the efficiency and cool running of the armature.

NEW LINE OF SMALL DIRECT-CURRENT MOTORS AND GENERATORS.

The armature core is of the slotted drum type, built up of special electric steel of a very thin gauge. The discs are carefully annealed and coated with insulating varnish. The discs are clamped together on the shafts under a strong pressure, and secured by keys against slipping and turning. The four-pole armature windings are composed of form-wound coils well insulated from each other, tested and assembled in units. These larger coils are then taped and dried and well varnished, insulated with a moisture-proof insulation, dried again and pressed in steam-heated moulds to exact shape and size. All the coils are consequently alike and interchangeable. The method of insulating the armature coils is the same as with high-voltage railway motors. The armature winding of the two-pole machines also consists of form-wound coils, taped and insulated from each other and the armatures. They are assembled on



ARMATURE COILS.

the core in the same manner as multipolar drum armatures, and are efficiently ventilated.

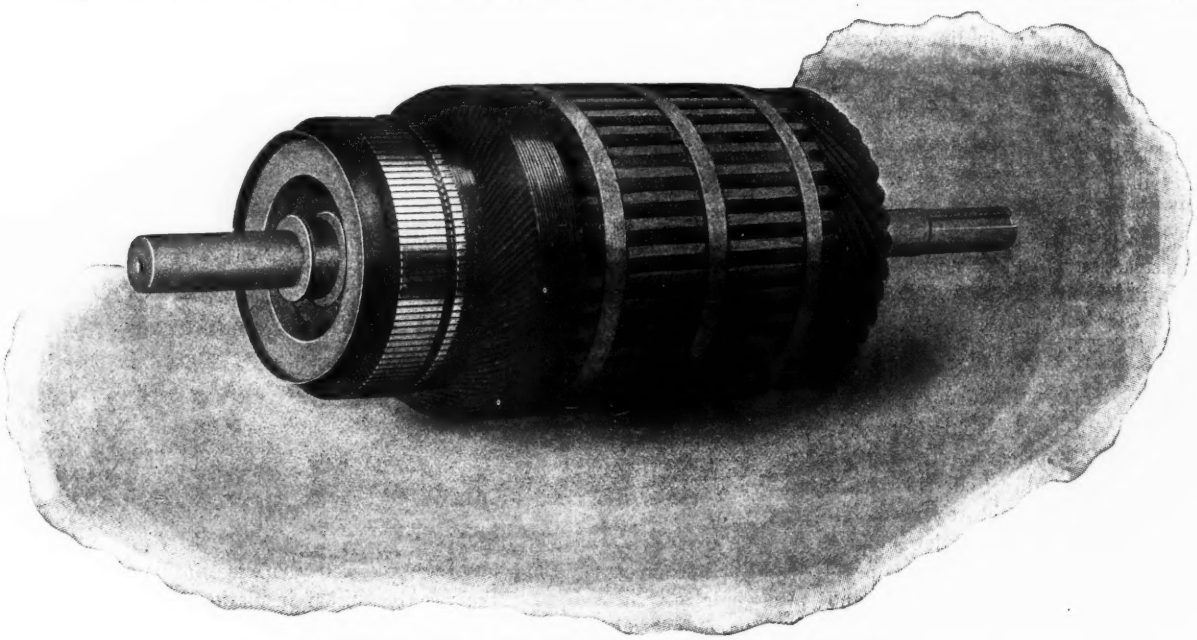
The commutator segments are of hard-drawn copper and the mica insulation has been carefully selected so as to secure a uniform rate of wear. To provide against grounds at the commutator, the inside insulating mica rings extend far out on each side, making it impossible for an accumulation of carbon dust to cause any considerable leakage of current. Special attention has been given to make the commutator solid and strong, and to thoroughly insulate the segments from each other and from the supporting parts. The diameter outside of the insulation is large, and ensures a long life of the commutator.

The brush-holder is of the well-known box type, supported on cast-iron rocker arms. Only the carbons move in the holder, and carefully calculated springs press the brush against the commutator. This pressure is maintained uniform during the life of the carbon by a peculiar construction of the hammer pressing on the carbon. All slideways of the carbons are accurately machined to fit the carbons, to prevent them sticking in the holder, and to eliminate excessive vibration. The holders are securely bolted to yokes of selected maple, which insulate them from the rocker arms. The yokes are well-seasoned, dried and soaked in paraffine, so as to obviate the possibility of warping or shrinking.

The magnet coils are form-wound, carefully insulated and varnished. They are thoroughly heated and baked to expel any moisture in the coils before the varnish is applied. A snug fit is made on the magnet cores, rapidly removing heat and preventing its accumulation in the coils. The laminated pole-shoes hold them in place, and, if desired, they may be easily taken out. The insulation, the manufacturer claims, is moistureproof and of great mechanical strength.

The shafts are large in diameter and are built to transmit, without vibration, the maximum power which the motors can deliver. The shafts run in bronze bearings provided with ring oilers fitted in oil chambers of large capacity. The terminals are brought out through flexible rubber-covered leads through holes drilled in the frames. These leads are well insulated, and especial care has been taken to make them durable under severe service.

The motor frames are semi-enclosed. The temperature rise of the motors is stated to be not over forty degrees centigrade in any part of the motor, and in the armatures and at the commutator the temperature rise ranges from twenty-five degrees centigrade in the smaller sizes to thirty-five degrees centigrade in the larger sizes. The motors may be furnished totally enclosed or with gauze covers over the openings. In this case the small motors can be run at full rating without a dangerous rise in temperature. Each motor is carefully inspected in every detail during the construction, and when completed is tested for full load and overload to ascertain that both electrically and mechanically it meets the requirements of a first-class machine.



ARMATURE OF NEW LINE OF SMALL MOTORS AND GENERATORS.

VARIOUS PARTS OF COMMUTATORS.

The Advanced Work of the Hudson River Electric Power Company.

The Hudson River Electric Power Company, Albany, N. Y., supplying power to the Utica & Mohawk Valley Railway Company, for the operation of its traction

lines between Rome and Litte Falls and in the city of Utica, has been notified by the latter company that it will require additional power, as the result of the electrification of the West Shore Railroad, between Utica and Syracuse, which is controlled by the Vanderbilt interests. It speaks volumes for the service rendered, and it is a source of gratification to the management of the Hudson River Electric Power Company to have its efforts to furnish a continuous source of power without interruption appreciated.

The power company has been supplying power to the railway company since July, 1905, and has erected a modern 5,000-horse-power steam turbine plant at Utica, to take care of this work.

The power company is installing on the boilers in its new steam turbine plant at Utica what is known as the "balanced-draught system"; by means of which the blower and damper are automatically controlled and the heated gases are retained and consumed before they escape to the flue. This is one of the latest improvements in steam boiler engineering and the results so far have been very satisfactory. A cheaper class of fuel can be used and better results obtained on this system than could be secured with the ordinary stoker system and a very high grade of coal.

The plant, when completed, will have a capacity of 10,000 horse-power and will consist of the latest and most modern apparatus of its kind in the country. Steam turbines of the Curtis type are used with Deane condensers and in the boiler room, the boilers being of the Franklin and Babcock & Wilcox water-tube types.

Power from this plant is being delivered to the Utica & Mohawk Valley Railway Company, at Utica, Frankfort, Little Falls and Oriskany, for the operation of the entire railway system.

The Utica station will also be connected by transmission lines with the water-power plants owned and operated by the Hudson River Electric Power Company, at Spier's Falls and Mechanicsville and at Schoharie Falls, as well as the proposed power plant on the Sacandaga river, above Spier's Falls.

In addition to supplying power to the Utica & Mohawk Valley Railway Company, the power company supplies all the electric power used in the following places: Albany, Troy, Green Island, Watervliet, Ballston, Saratoga, Glens Falls, Schenectady and Amsterdam; which are included in the territory bounded on the north by Whitehall; on the south by Hudson, on the east by Albany and on the west by Syracuse. About 40,000 horse-power is at present used in this territory and contracts to the extent of 50,000 horse-power are being considered at the present time.

The power company reports an increased demand for power from the Watervliet arsenal, at present using about 300 horse-power. This has been in service during the past year, and the officers of the arsenal are so well pleased with the satisfactory service rendered that they have notified the power company that 200 horse-power in addition will be required, and the order has been placed for the necessary electrical apparatus.

A 60,000-volt transmission line is being constructed from Ballston to Utica, *via* Amsterdam, and the power company has introduced an innovation, in this part of the country, in the way of steel tower lines, doing away with the old-style wooden poles.

The towers are to be fifty feet high and will consist of structural iron or steel. The foundations will be made of concrete and crushed stone and bolts will be set in same, to which the base of the towers will be bolted. They will be set about 550 feet apart, or ten to the mile, and will be so arranged that two three-phase circuits can be carried.

The security of this system over the present pole line is very marked, as the towers can not be affected by lightning discharges, such as with the old wooden structures. Special towers are being designed for long crossings and for river work. The first of these towers will be tested in the power company's testing yard at Watervliet in a few days, and after receiving the engineers' approval the work will be started at once on the line extending from Ballston to Amsterdam and from there to Utica.

Information for the Baltimore Electrical Directory.

The Electric Company, with general offices at the Continental Building, Baltimore, Md., is seeking information concerning the names and addresses of makers of electrical machinery, such as air-compressors, motor-driven coffee-mills and meat grinders, drills, lathes and other machine tools, refrigerating machinery and pumps. The information is desired in connection with a new edition of the Baltimore Electrical Directory, to be published by the Electric Company, which is soon to go to press. Information is requested from those firms which either build or sell appliances provided with the motors, or that are specially arranged for electric drive.

A New Pendant Quick-Break Switch.

The Sarco Company, 906 Sixth avenue, New York city, manufacturer of standard wiring specialties, is meeting with great success among the electric lighting stations and the trade generally with its new pendant quick-break switch shown in the accompanying illustration. The switch is especially adapted for controlling ceiling lights, clusters and arc lamps, and while it is rated for six amperes and 125 volts, it has, in actual test, carried, without any noticeable heating twice this amount of current and twice the voltage. These switches are made in a number of different finishes to harmonize with the surroundings. The switch proper is mounted in a solid piece of porcelain, and consists of two levers working on a rocker, causing, by means of two spring triggers and a double V-cam, the necessary reciprocating movement. The up-and-down movement of the two levers is guided by the construction of the porcelain holder so that the action is that of

QUICK-MAKE, QUICK-BREAK PENDANT SWITCH.

a quick-break switch, there being, however, no action of the switch jaws until a quick and clean make-and-break is desired, which is accomplished so positively and rapidly that, with the large contact surfaces, no arcing or heating is effected.

The careful workmanship and material used in these switches have made them, the maker states, practically indestructible.

The push-buttons for operating the switch are marked for "on" and "off," one button being inlaid with pearl and the other concaved and ridged. These switches are fitted with double bushings, the larger bushing being screwed into the top of the metal cap, and the smaller bushing threaded within the larger, so that, where it is desired to use reenforced instead of standard pendant cord, the smaller bushing may be removed, and the pendant is still properly bushed by the larger one.

This new switch is now being carried in quantities in the stockrooms of central stations for the convenience of their customers.

New Gasoline Motor Car.

The accompanying illustration shows a No. 16 gasoline motor car manufactured by Fairbanks, Morse & Company, Chicago, Ill., and is one of several different styles of cars of this class they are at present building.

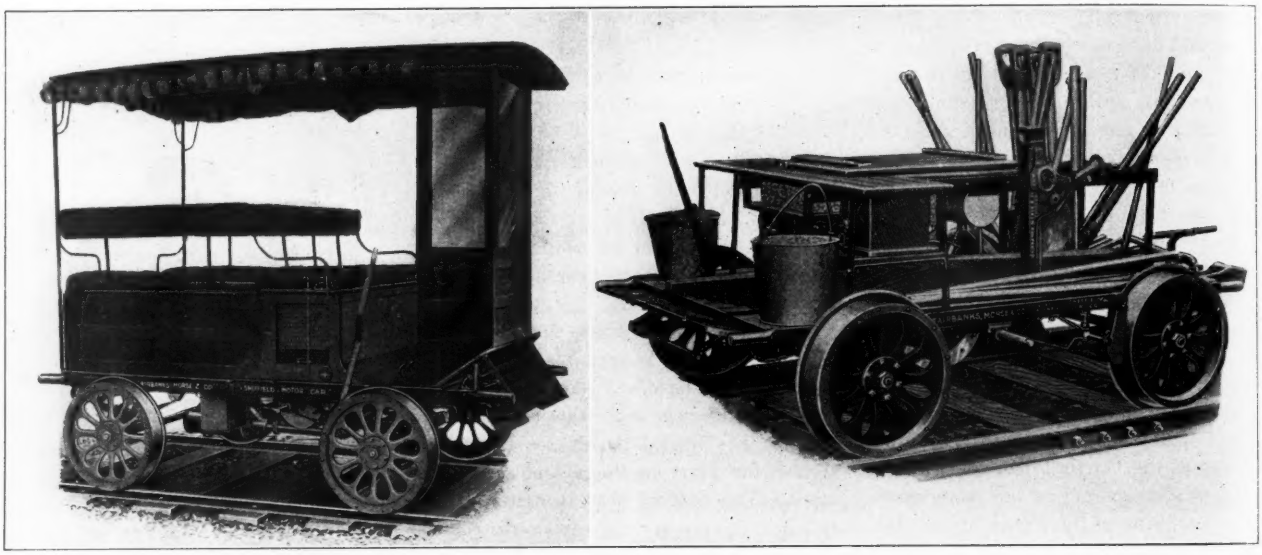
Early in the summer of this year Mr. George H. Webb, chief engineer Michigan Central Railroad, made an inspection trip over the system with one of these cars, and below is some data which is of special interest, showing, as it does, what has been actually accomplished with the gasoline motor.

Total distance traveled by the car was 4,347 miles and the total amount of gasoline used was 231 gallons, or an average of 19.7 miles per gallon of gasoline. The records show that on the run from Jackson to Allegan, a distance of 175 miles, round trip, only seven and one-half gallons of gasoline were used, or 23.3 miles per gallon. The total cost per mile, including lubricating oil, battery cells and everything excepting wages of man in charge, was nine-tenths of a cent.

This gasoline car has its advantages also, because of its ability to attain a high rate of speed and maintain it on a long run. From Marshall to Allegan, 66.4 miles distance, was made in one hour and forty minutes, or at the rate of forty miles per hour, and they report they never stopped the engine once. The distance from Tekonsha to Harrison, twenty-nine miles, was made in forty-five minutes, and the best run of the entire trip was made from South Haven to Kalamazoo, a distance of 39.6 miles, in forty-five minutes, or at the rate of 52.94 miles per hour.

The No. 16 motor car is arranged to seat nine people, and is guaranteed to operate to a speed of thirty-five miles per hour ahead, and twelve miles per hour reverse, at the will of the operator. The frame is made of steel securely riveted. The power is supplied by a two-cylinder, twelve-horse-power gasoline engine. The car is regularly equipped with a canopy top, glass front and leather-upholstered seats. The rear seats can be removed, making the car available for carrying packages or material. The weight of the car is 1,650 pounds.

Car No. 14, which is also shown herewith, is designed particularly for carrying working men and tools. It has a seating capacity of eight to nine persons, with a total weight of 1,100 pounds. The motive power is a one-cylinder, six to seven-horse-power gasoline engine. The gasoline capacity is two and one-half gallons, and the car has two speeds forward and one reverse.



GASOLINE MOTOR CARS FOR RAILWAY EMERGENCY AND AUXILIARY SERVICE.

The Meeting of the Massachusetts Street Railway Association.

The Massachusetts Street Railway Association met at Young's Hotel, Boston, Mass., on the evening of Wednesday, December 13. President E. P. Shaw was in the chair. The Hon. W. Caryl Ely, of Buffalo, N. Y., and Bernard V. Swenson, New York city, president and treasurer, respectively, of the American Street and Interurban Railway Association, were the guests of the evening. Messrs. Ely and Swenson suggested plans by which the national and state associations could cooperate in improving the service and in adopting standards of equipment and discipline.

Changes in the Board of Directors of the Maryland Telephone and Telegraph Company.

At the meeting of the board of directors of the Maryland Telephone and Telegraph Company, held at Baltimore, Md., on December 11, four of the directors resigned, and their places were filled. Mr. George R. Webb, the first president of the company and the principal stockholder, was chosen to fill a vacancy which has existed on the board since he retired from the directorship about a year ago. The following directors were elected: Mr. B. N. Baker, president, Baltimore Trust and Guarantee Company; Mr. Reuben Foster, president, Chesapeake Steamship Company; Mr. Sydney L. Wright, Philadelphia, Pa.; Mr. W. Frederick Snyder, Philadelphia, Pa. These directors take the place of Mr. C. I. T. Gould, Mr. Charles T. Westcott, Mr. John T. Stone and Mr. Robert Ramsay.

Independent Telephone Men of West Virginia.

At a meeting of the executive committee of the Independent Telephone Association of West Virginia, held on the afternoon of December 7 at the office of W. C. Handlan, manager of the National Telephone Company, of Wheeling, W. Va., it was decided to hold the first meeting of the association at the Chancellor Hotel, Parkersburg, W. Va., on February 22 and 23, 1906. At this time representatives of all the independent companies in the state, and also many from other states, will be invited to be present.

The members of the executive committee who attended this session were A. E. Davis, general manager of the West Virginia Telephone Company, Parkersburg; J. Walter Barnes, general manager, Consolidated Telephone Company, Fairmount; W. C. Handlan, National Telephone Company, Wheeling.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

ELECTRICITY FOR THE PORT HURON-SARNIA TUNNEL—It has been announced that the St. Clair Tunnel Company has let the contract for the equipment of the Port Huron-Sarnia tunnel with electricity for the operation of trains. The contract involves the building of large power-houses in Port Huron and Sarnia, and the total cost, it is said, will be $680,000.

THE TELEPHONE SYSTEM AT PANAMA—A company has been organized to exploit the franchises granted to Mr. E. F. Lefevre for establishing telephone service in Panama and Colon. This company will be known as the Compania de Telefonos. Dr. John Lundie, 17 Battery place, New York city, will have charge of everything in connection with the installation, purchase of machinery, etc. A central energy-system will be established at Panama. Arrangements are being made with the canal commission to connect its central with the Compania de Telefonos exchange, and in this way the canal zone, Panama and Colon will have intercommunication.

CHATTANOOGA & TENNESSEE RIVER LIGHT AND POWER COMPANY TAKES LARGE MORTGAGE—Gold bonds to the amount of $3,500,000, to mature in fifty years, will be issued by the Chattanooga & Tennessee River Light and Power Company. To secure these bonds, a first mortgage on all the present and anticipated holdings of the lock and dam enterprise has been filed with the county registrar at Chattanooga, Tenn. The Central Trust Company, of New York, holds the mortgage. The real estate holdings of the company consists of forty-five acres on the south side of the Tennessee river, and a like tract on the north side, abutting upon the site of the lock and dam.

ERIE RAILROAD MAY OPERATE ELECTRIC LINE—It has been stated that the Erie Railroad has determined upon the construction of an electric line from Binghamton to Corning, N. Y., a distance of seventy-six miles. The new line will parallel the present line of the Erie between these two points, and is intended to care for local passenger traffic. The surveys for the line are to be made immediately, and the contracts for construction work will probably be let in January. The cost of the line, it is estimated, will be in the neighborhood of $1,500,000. The line, starting from Binghamton, will run through the towns of Union, Owega, Southboro, Waverly, Chemung, Elmira and Horseheads, ending at Corning. At this point the northern line of the Erie diverges from the main line.

AN ELECTRIC ROAD TO THE SEA—The directors of the West Jersey & Sea Shore Railroad have approved a plan for electrifying the main line between Philadelphia and Atlantic City. This is regarded as one of the most important steps taken in the substitution of electricity for steam traction. It is understood that all of the trains which run between Philadelphia and Atlantic City will be operated by electricity. The contract has been let to the General Electric Company, which will install the necessary power stations. These are to be equipped with Curtis turbines. The cars will have direct-current motors, and the Sprague-General Electric multiple-unit-control system. The entire cost of the change will be between $2,000,000 and $3,000,000. Work will begin at once, and by next summer electric service is expected to be in operation. Express trains will be run on a fifteen-minute headway between Philadelphia and Atlantic City. A local electric service will also be installed on the lines between Philadelphia and Millville and Philadelphia and Woodbury. The line between Philadelphia and Atlantic City is about sixty-three miles long.

SOUTHERN PROPERTIES PURCHASED BY A NEW YORK SYNDICATE—A New York syndicate has completed negotiations for the purchase of several street railway, electric light and hotel properties in Augusta, Ga., and Aiken, S. C. It is stated that these properties amount in value to $5,000,000. The properties under consideration are the Augusta-Aiken Railway and Electric Company, the Augusta Railway and Electric Company, the North Augusta Electric and Improvement Company, and the Augusta & Aiken Railway Company. The Augusta-Aiken Railway and Electric Company has issued $1,434,000 in common stock, $786,000 in preferred and $1,244,000 in first mortgage five per cent bonds. The Augusta Railway and Electric Company has issued $1,000,000 common stock and $1,000,000 bonds. This company operates twenty-nine miles of railway. The North Augusta Electric and Improvement Company has a capital of $1,000,000 common stock, $500,000 preferred stock and $1,000,000 bonds. This company owns 4,000 acres of land in Aiken county, S. C., opposite the city of Augusta, also the waterworks, sewerage and public and private lighting system of North Augusta and the Hampton Terrace Hotel. The Augusta & Aiken Railway Company owns an electric line which connects Augusta with Clearwater, Bath, Langley, Warrenville and Aiken. It operates twenty-six miles of line.

NEW INCORPORATIONS.

INDIANAPOLIS, IND.—Louisville & Northern Railway and Lighting Company. $5,000,000.

JERSEY CITY, N. J.—The Luzerne Light, Heat and Power Company, Jersey City. $200,000. Incorporators: Thomas H. Sheridan, Guy B. Hurlbut, and Maturin Ballon.

LOS ANGELES, CAL.—Inner Harbor Gas and Electric Company. $200,000. Directors: C. J. Walker, H. S. Farnsworth, W. B. Redburn, H. T. Cooley and others of Long Beach.

JEFFERSON CITY, MO.—Kirksville Gas, Heat and Electric Company, of Kirksville. $30,000. Incorporators: Benjamin F. Henry, Fred Grassee, Charles S. Sands, Frank J. Storm, William P. Foster and others.

INDIANAPOLIS, IND.—Michigan City Light and Power Company, Michigan City. $150,000. Directors: Robert F. Garrettson, James M. Garrettson, John H. Garrettson, William H. Schoenemann and F. H. Willson.

HAGERSTOWN, MD.—Blue Ridge Railway Company. $15,000. Incorporators: John W. Wolf and William L. Minck, Franklin county, and J. Clarence Lane, H. H. Keedy, Jr., and J. Irvin Bitner, Washington county.

CLEVELAND, OHIO—South Lorain & Eastern Traction Company. To build an electric line between Cleveland and Lorain. $1,000. Incorporators: Segnuind Lederer, Arthur A. Lederer, A. B. Stuber, D. T. Miller and R. C. Linden.

GUTHRIE, OKLA.—The El Reno Gas and Electric Light Company. $150,000. Directors: George J. Hickox and F. N. Howell, of El Reno; M. G. Clark and Mile D. Campbell, Coldwater, Mich.; H. H. Stephen, Brookfield, Mo., and Harry T. Harvey, Battle Creek, Mich.

FAYETTEVILLE, W. VA.—Big Clear Creek Railway Company, of Charleston. To build a railroad from Rupert, in Greenbrier county to Richmond, Nicholas county. $10,000. Incorporators: C. B. Couch, E. A. Reid, Frank Cox, George H. Shrewsbury and Geo. S. Couch, Jr., all of Charleston.

SPRINGFIELD, ILL.—Cook County & Southern Railway Company, Chicago. To construct a line from Franklin Park in a southwesterly direction to Gary, both in Cook County, Ill. $50,000. Incorporators and first board of directors: James S. Hopkins, Royal Wright and Edwin H. McKinney, of Chicago; John N. Peffers, of Aurora, and George W. Childs, of Hinsdale.

ALBANY, N. Y.—The Geneva, Phelps & Newark Electric Railway Company. Organized for the purpose of constructing and operating an electric railway between the city of Geneva and the village of Newark, Wayne county. $400,000. Directors: S. W. Hayes, E. H. Palmer, L. G. Hoskins, T. H. Chew, W. A. Clarke, O. J. C. Rose and Theodore J. Smith, of Geneva; S. S. Partridge, of Phelps, and E. K. Burnham, of Newark.

TELEPHONE AND TELEGRAPH.

INWOOD, W. VA.—The Inwood Rural Telephone Company has been organized to construct a telephone system.

MUSCATINE, IOWA—The Mississippi Valley Telephone Company will place its wires underground. Work is to be begun early in the spring.

ABERDEEN, WASH.—A new telephone exchange is to be built in Aberdeen and improvements worth $20,000 made to better the service in that city.

PHILADELPHIA, PA.—A two-story branch exchange will be erected for the Bell Telephone Company by John R. Wiggins & Company, at a cost of $40,000.

SAGINAW, MICH.—The Michigan Bell Telephone Company will expend about $100,000 for the installation of a complete central energy system for Saginaw.

SAVANNAH, GA.—The Georgia Telephone Company has announced that its subscription list has recently increased to the number of 3,275 subscribers.

DELAWARE CITY, DEL.—The Diamond State Telephone Company is increasing the value of its service in Delaware City, and purposes extending its lines to the rural districts.

NEWBERG, ORE.—The West Newberg Telephone Company has been organized and the line will soon be in readiness for use. J. H. Bidgood is president, and A. Berrell, secretary of the company.

WAVERLY, TENN.—A telephone line from McEwin through the county to points on Hurricane creek is in course of erection. Dr. Robertson and P. J. Fuqua are the prime movers in the enterprise.

LOVELAND, IOWA—The Woodbine Telephone Company is building a new line from Woodbine to Honey Creek. At the latter place connection will be made with the independent line to Council Bluffs.

DANVILLE, IND.—R. D. Stone, of Clayton, has purchased the stock of the Clayton Telephone Company. He will begin at once to put the lines and instruments in good condition, and will build extensions.

SAUK CENTER, MINN.—The Pleasant Valley Telephone Company, a new organization, has begun work constructing a line south from Sauk Center. The object is to connect with the rich farming district in Pleasant valley.

AUBURN, N. Y.—A certificate of increase of capital stock of the Woodworth Telephone and Telegraph Company, of Union Springs, from $15,000 to $30,000, has been filed in the county clerk's office. The action was taken at a special meeting of the company held September 25.

LOCKPORT, N. Y.—It is stated that a telephone line will be constructed by the Niagara, Lockport & Ontario Power Company along the route of its power transmission line from Niagara Falls to Syracuse. William Gibbony, of Buffalo, has charge of the telephone work, and has opened offices in Lockport.

ALBANY, N. Y.—The Franklin County Telephone Company and the Racket Telephone Company have filed a certificate of merger with the Adirondack Home Telephone Company, of Franklin county. Irving Griswold, of Elyria, Ohio, is president. No mention is made of the amount of capital stock of the new company.

OXFORD, N. Y.—At a meeting of the stockholders of the Oxford Valley Telephone Company a resolution was passed authorizing the company to extend its line up the east side of the river to Lyon Brook, connecting with the Lyon Brook company, which gives connection with Mount Upton and the Unadilla valley.

PEORIA, ILL.—A farmers' telephone line, one of the largest and most extensive of its kind, is to be connected with the Peoria exchange of the Interstate Telephone Company within a short time. The line extends from El Paso to Peoria, and the whole of it is being built by what is known as the Farmers' Mutual Telephone Company.

OAKLAND, CAL.—The Sunset Telephone and Telegraph Company has started work on its new underground conduit system in the city of Oakland. This includes the placing of something over sixty blocks of wires underground, at a cost of $110,000. The company has also commenced work reconstructing its outside plant, the cost of which will be $80,000. The new building of the Sunset Telephone and Telegraph Company has been commenced; it will cost about $20,000.

HAVRE, MONT.—The stockholders of the proposed telephone line from Havre have elected J. S. Almas, president; J. F. Valadon, vice-president, and Henry J. Meili, secretary and treasurer. The directors were authorized to proceed at once to construct the line, which will be known as the Havre-Box Elder Telephone Company. The company is capitalized at $5,000.

ALLENTOWN, PA.—At a meeting of the board of directors and the executive committee of the Consolidated Telephone Companies of Pennsylvania, orders were placed for the installation in Allentown of an automatic exchange of 4,000 lines, and similar exchanges of smaller capacity in Hazleton, Luzerne county, and Emaus, Lehigh county. The improvements will cost $100,000.

KAUKAUNA, WIS.—The Wisconsin Telephone Company has completed plans for the rebuilding of the exchanges at Kaukauna, Appleton, Neenah and Menasha. A new office building will also be erected at Appleton. Two additional copper circuits will be built from Kaukauna to Appleton, Manitowoc and Green Bay, making six circuits to Appleton and four each to Manitowoc and Green Bay.

CORTLAND, N. Y.—Negotiations which have been in progress between the stockholders of the Home Telephone Company, of Cortland, and the Bell company for some weeks have been completed and the Bell company now holds a majority of the common stock of the local company. The Home company still owns a large percentage of the stock, but the management is in the hands of the Bell people.

UNIONTOWN, PA.—The last link in the long-distance lines of the American Telephone and Telegraph Company from Pittsburg to Grafton, W. Va., a distance of about 109 miles, has been completed. The line follows county roads all through Fayette county, coming from Pittsburg *via* Perropolis. The local result of this line is that the Bell company in Fayette county gets privileges over the long-distance poles.

SALEM, ORE.—City council has passed the ordinance granting a franchise to the Automatic company. The ordinance, as passed, requires the company to pay the city $10,000 in cash for the franchise; and when the exchange is completed and in operation the company must pay the city annually three per cent of the gross income. The promoters promise to begin work on the construction of the plant at once.

RIVERHEAD, L. I.—The board of directors of the Baiting Hollow & Roanoke Telephone Company has voted to ask the stockholders to authorize the increase of its capital stock from $20,000 to $50,000, and it is believed that this will be done in the near future. This company, started by farmers a few years ago to connect their farms throughout the rural districts, is having a phenomenal growth. It began with $5,000 capital.

CHILLICOTHE, MO.—The sale of the Carrollton and Kirksville telephone exchanges to the Bell company has been consummated. Ninety thousand dollars was the price paid for the Carrollton exchange. It is stated that the Bell company has secured contracts of sale from the owners of the independent exchanges at Brookfield, Linneus, Marceline and Trenton and half of the Richmond exchange, which is owned by a partnership.

WINCHESTER, IND.—At a meeting of the stockholders of the Winchester Telephone Company a deal was consummated whereby the Parker City plant, including toll lines to Albany and Losantville and the Losantville local plant, is to be merged with the local company. A new concern to be known as the Eastern Indiana Telephone Company has been organized, and the capital stock increased from $50,000 to $150,000. The officers of the Winchester company will serve in the new organization.

HUNTSVILLE, ALA.—The Inter-County Telephone Company has finished the construction of a system of telephones covering the southeastern part of Morgan county and connecting with the Southern Bell exchange of Huntsville. The system includes ten toll stations. The exchange will be located at Valhermosa. The Inter-County company was incorporated with a capital stock of $20,000 for the purpose of putting in a system covering sixty miles. The officers are: C. E. Hogeboom, president; Gus May, vice-president, and Charles Hogeboom, secretary.

ELECTRIC LIGHTING.

WAKEFIELD, MASS.—Work has been begun on the extension and improvement of the Wakefield lighting system.

PROVO, UTAH—The $91,000 of bonds for the Provo electric light plant and waterworks has been awarded to N. W. Harris & Company, of Chicago, Ill.

BURLINGTON, VT.—At a regular meeting of the board of aldermen a resolution was adopted fixing the rates for furnishing municipal electricity for power purposes.

RIDGEFIELD, CT.—Work has been commenced on the plant for the Ridgefield Electric Light Company. The contract calls for the completion of the plant some time next May.

NEWARK, N. Y.—At a special meeting of the village board of Newark a franchise was granted to the Niagara, Lockport & Ontario Power Company to erect poles and string cables through the village.

UNION, N. Y.—At the special tax election to vote on the question of bonding the village of Union to the amount of $15,000 for a village electric light plant the proposition was carried by 102 votes for and seventeen against.

SALIDA, COL.—The water-power plant of the Salida Light, Power and Utility Company has been completed at a cost of $85,000. The plant is capable of producing 25,000 horse-power. Current will be furnished to adjacent camps for operating mining machinery.

ARCADIA, N. Y.—A franchise has been granted the Niagara, Lockport & Ontario Power Company by the Arcadia town board to construct and operate the necessary appliances upon all the public highways of the town of Arcadia for the purpose of furnishing electricity for light, heat and power.

BREESE, ILL.—The contract for building the electric light plant has been awarded to the Electric Steam Engineering Company, of St. Louis. This company will build the plant complete excepting the power-house. The entire system will cost about $27,000, and will be in operation by April 1.

NIAGARA FALLS, N. Y.—The work of placing the seven water wheels and generators at the plant of the Ontario Power Company, is progressing rapidly. Already three wheels and generators of 10,000 horse-power each have been placed in position, and are in operation, and the fourth will soon be in readiness.

CUMBERLAND, ME.—The annual report of the electric light commissioners of Cumberland shows Cumberland to be lighted more cheaply than any other city in the country. The cost per arc light for the year was $34.06. There are 203 arc lights in use. Before the city erected its own plant the cost per light was $90 a year.

ROCHESTER, IND.—The case of the town of Rochester *versus* the Electric Light Company, which has been pending in court for several months, has been decided in favor of the light company. It was decided that the ten-year contract could not be annulled and that the town must pay the light company $12,096.28 due for back lighting.

PLATTSBURG, N. Y.—The Malone Light and Power Company has completed a contract with the Chateaugay Electric Light and Power Company, by the terms of which the latter company is to furnish to the former electricity to the amount of 200 horse-power. The Chateaugay company will extend its lines to Malone Junction as soon as possible.

ALBANY, N. Y.—The state commission of gas and electricity has consented to the consolidation of the Consumers' Light and Power Company and the Orange County Lighting Company, of Middletown. It is stipulated that the consideration for the transfer of the Consumers' stock shall not be more than $43,000. It is also agreed that the price of electricity shall not be increased in the next five years.

KNOXVILLE, TENN.—The contract with the Knoxville Railway and Light Company for lighting the city by electricity was signed at a special meeting of the board of public works. The new contract for 303 arc lights dates from October 24, 1905, and the city pays at the rate of $72.50 per light per year. The former contract for lighting the city was $80 per year, a saving to the city of $7.50 per light, or a total of $2,272.50 per year.

RED WING, MINN.—The Red Wing Gas and Electric Company has sold its entire plant and system to a syndicate of capitalists from Detroit, Mich., composed of P. C. Thompson, F. A. Platt, Ralph L. Aldrich and A. E. F. White. The local company is capitalized for $155,000, including bonds of $65,000. The new syndicate owns the electric plants in eighteen other cities in the country and proposes to expend $40,000 immediately on improvements.

NORTH TONAWANDA, N. Y.—The North Tonawanda aldermen have granted a franchise to the Niagara Falls Electric Transmission Company. This application has been before the council since last spring. The franchise is for fifty years and provides that the company shall, within five years, be prepared to furnish 5,000 horse-power to the city for light and heating purposes, and at prices as low as it furnishes similar service to Lockport, Buffalo or other nearby towns.

WORCESTER, MASS.—The annual report of the Worcester Electric Light Company, for the current fiscal year, has been filed with the state board of gas and electric light commissioners. The report shows total assets of $1,081,049.75, of which $601,663.51 is for electric lines, $110,559.19 for electric plant and $97,007.97 for real estate. The total liabilities amount to $786,335.90, of which $600,000 is for capital stock. The profit and loss balance is $294-713.85 in its capitalization.

PITTSBURG, PA.—Dr. H. B. Burns presented in select council a resolution authorizing the appointment of a joint committee of seven to enquire into the cost of a municipal electric light plant. The birth of the movement followed the introduction in the same branch of franchise ordinances for the City Electric Company and the Southside Electric Manufacturing Company. The resolution was adopted and in the evening the common council concurred in its approval. The committee to report in January.

ATLANTIC CITY, N. J.—The recently incorporated Lebanon Electric Light, Heat and Power Company, of which Charles V. O'Donnell is president and Joseph C. Farr, secretary and treasurer, was granted a franchise on December 1 by the township committee of Lebanon township, Hunterdon county, to erect poles and suspend wires for the purpose of lighting the township named. It is understood that the new corporation has purchased a tract of land located in the borough of Glen Gardener and will erect a modern electric plant.

LOCKPORT, N. Y.—The citizens of Lockport have adopted the report of the committee favoring the proposition of the Niagara, Lockport & Ontario Power Company to give the city current over its transmission line at $16 per horse-power in return for release from certain obligations requiring the building of the so-called power canal. In addition to the cheap power, the power company agrees to give the city $3,000 a year for advertising purposes and a bonus of fifty cents per horse-power for all over 6,000 sold in Lockport each year.

PITTSBURG, PA.—The Allegheny County Light Company has entered into a contract with the council of Verona, in Allegheny county, to supply the borough with light at the rate of $65 an arc light. The contract is made for one year, with the privilege of the Verona council extending it to five years. The Allegheny County Light Company has the same contract with the borough council of Oakmont, adjoining Verona. The power is produced at a plant between Verona and Oakmont, built by the Oakmont & Verona Light, Heat and Power Company, which sold out to the Allegheny County Light Company two years ago.

LURAY, VA.—The Shenandoah River Power and Light Company has been organized with the following officers: president, T. J. Berrey; vice-president, Charles S. Landram; directors, A. L. Jamison, J. W. Ruffner, S. A. Walton, J. C. Burner, Jr., W. Grove, F. G. Grove, T. J. Berry and Charles S. Landram, all of Luray. The company is building a dam across the Shenandoah river two miles west of Luray, which will develop from 600 to 1,200 horse-power. It will furnish light and power to Luray and Page county. The Luray Electric Company was organized about a year ago and has the contract for lighting the town and the Luray caverns.

ELECTRIC RAILWAYS.

PALESTINE, TEX.—A fifty-year franchise has been granted to J. B. Watkins and associates, of Corsicana, Dallas and Kansas City, for an electric road.

MONROE, LA.—The Monroe city council has authorized the mayor of Monroe to contract for material and equipment for the construction of a street railway.

NASHVILLE, TENN.—The Louisville & Nashville Railroad will shortly establish an interurban service on the Henderson division of the road between Madisonville, Ky., and Nortonsville, Ky., a distance of eleven miles.

MORGANTOWN, W. VA.—At a special session of the Marion county court an order was passed granting the Dunkard Valley Trolley Company a franchise. The proposed road will connect Morgantown and Mannington.

TERRE HAUTE, IND.—The Indianapolis & Western Traction Company, which is building west from Indianapolis, has made an agreement with the Terre Haute company to use the latter's tracks from Harmony to Terre Haute, twenty miles.

LOUISVILLE, KY.—The Beargrass Railway Company may extend its lines from Jeffersontown to Shelbyville. Engineers will soon make a survey of the route in order to get an estimate of the cost and the time necessary for such constructions.

CHATTANOOGA, TENN.—The Tennessee-Georgia Interurban Electric Railway, which is proposed to be built from the central portion of Chattanooga through Walker and Catoosa counties, Ga., to Spring Place, has applied for an increase in its capital stock from $300,000 to $500,000.

PITTSBURG, PA.—The capital stock of the Pennsylvania & Mahoning Valley Electric Railway Company has been reduced from $3,000,000 preferred and $5,000,000 common to only $1,000 common stock. The company was recently merged into the Shenango & Mahoning Valley and Light Company, controlling the street cars of Newcastle, Youngstown and Sharon, Pa.

BUFFALO, N. Y.—The Mohawk Valley Company, the trolley company of the New York Central Railroad, is preparing plans for the electrical equipment of the Auburn branch from Syracuse to Rochester, utilizing the Rochester & Eastern as far as possible. It is also preparing plans to electrically equip the Falls line from Rochester to Niagara Falls, using the right of way of the Falls division of the Central road.

OMAHA, NEB.—The stockholders of the Des Moines-Winterset-Creston Interurban Railway held their first meeting in Des Moines recently. They adopted articles of incorporation, elected officers and completed plans for the new road. The company contemplates a line from Des Moines to Winterset, thence to Macksburg and to Creston. The principal offices are to be in Des Moines. Work will be started on the line at once.

SCRANTON, PA.—W. A. Heller, of Danville, Pa., is promoting an electric street railway to operate between Seeleyville and Hawley. The new road will be known as the Honesdale & Hawley Electric Railway. It will be twelve miles in length, with terminals at Seeleyville and Hawley, and the power plant will be located at Honesdale. A charter will shortly be applied for, and it is hoped that work will begin in the spring.

WELLSVILLE, OHIO—The East Liverpool Light and Power Company has a corps of surveyors at work making the final survey for extension from the Wellsville city limits to Empire, Ohio, a distance of probably nine miles west of the county line. At Empire a connection is to be made with the lines of the Steubenville & Ohio Valley Traction interests, the lines of which extend now from Brilliant, Ohio, to the east end of the Toronto, Ohio, city limits and border upon the city limits of Empire.

DOYLESTOWN, PA.—C. P. Hoffman, A. L. Cope and W. H. Lauer, of South Bethlehem, and Hugh Crilly, of Allentown, have received a charter and the right of way and will construct a trolley road from South Bethlehem to Centre Valley. At that place connection will be made with the Philadelphia & Lehigh Valley Transit Company's line. At the upper end of the line connection will be made with the Eastern Transit Company, making a through line from Easton to Philadelphia. The new trolley will shorten the distance from Bethlehem to Philadelphia several miles.

UTICA, IND.—Ebenezer Howes, of Utica, is at the head of a movement to build an electric line from Utica to a connection with the Louisville & Southern Indiana Traction Company. Utica township is the richest farming country in southern Indiana. At present it has no connection with Louisville except by stage coach and wagon-way over the Utica pike from Jeffersonville. Mr. Howes says the farmers in that section will subscribe liberally for the stock. Louisville men have subscribed $10,000 and indications are that the road will be built, it will be about eight miles in length.

MARION, IND.—A novel step has been taken by the Chicago, Indiana & Eastern Railroad Company, which, it is said, proposes to sell its locomotives and equip the line with electricity. The road operates between Converse and Muncie. It passes through Fairmount, ten miles south of Marion, but it is the intention of the company to build an electric line from Matthews to Marion and to abandon the present line from Matthews to Converse, which passes through Fairmount. The franchise presented to the county commissioners asks for a franchise to operate steam and electric trains, but the franchise presented to the city board of public works asks for a franchise to operate only electric trains within the city limits.

PITTSBURG, PA.—It is announced that the Pittsburg Railways Company has purchased the interests of the Washington & Canonsburg Street Railway Company. The officers of the last-named corporation are: president, Francis J. Torrance; vice-president, Arthur Kennedy; secretary and treasurer, H. C. Hagan. The price paid for the property of the Washington county company is said to have been $1,125,000, of which $475,000 was cash, the purchasing company assuming bonds for the balance. The company has about twelve miles of track. It controls charters for other roads, although it has no additional franchises outside of Washington and Canonsburg. It is believed that it will be connected with the Pittsburg system at Charleroi or Finleyville.

WESTFIELD, MASS.—It is announced that arrangements have been made for the transfer of the Woronoco and the Western Massachusetts Street Railways to the Consolidated Street Railway Company, a corporation controlled by the New York, New Haven & Hartford Railroad. The Consolidated company is the one which some time ago purchased control of the Berkshire and the Springfield street railways. The price to be paid for the Woronoco Street Railway Company's stock is $175 a share. An option is given the Woronoco shareholders of taking in exchange the Consolidated company's six per cent bonds at $180. The Woronoco road has a capital stock of $250,000. It has seventeen miles of track, and connects with lines running to Springfield, Holyoke and towns to the westward. The Western Massachusetts Street Railway is a branch of the Woronoco company.

ENGINEERING SOCIETIES.

TORONTO (ONTARIO) BRANCH, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—The executive committee of the Toronto branch of the American Institute of Electrical Engineers announces with regret the acceptance of the resignation of Mr. H. A. Moore as chairman. This resignation has been rendered imperative through removal from the city. At the twenty-sixth regular meeting, held December 8, Mr. R. T. MacKeen, upon the recommendation of the executive committee, was unanimously elected chairman, still retaining the office of secretary.

ST. LOUIS (MO.) BRANCH, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—The St. Louis branch of the American Institute of Electrical Engineers held its meeting at the Engineers' Club, December 13. Mr. Richard McCulloch presided. The meeting was largely devoted to a discussion of methods for reviving interest in the branch meetings. Steps were taken with a view of increasing the local membership and to effect, if possible, some working policy with the Engineers' Club, of St. Louis. The two papers read at the 201st meeting of the Institute in New York city were read in abstract and discussed by those present. Mr. A. S. Langsdorf is secretary of the St. Louis branch.

PERSONAL MENTION.

MR. ROBERT T. LOZIER has been appointed district sales manager of the gas and machinery department of the Power and Mining Machinery Company. Mr. Lozier's headquarters will be at 52 William street, New York city.

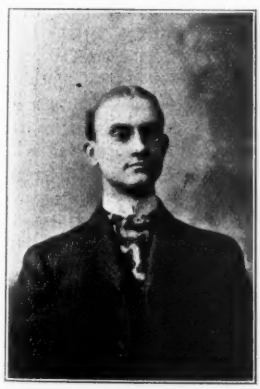
MR. E. J. KULAS has been appointed secretary and general manager of the Brilliant Electric Company, Cleveland, Ohio. Mr. Kulas was for some years connected with the Buckeye Electric Company, and later with the Bryan-Marsh Company, both in New York and Chicago.

MR. L. B. STILLWELL and Mr. John Van Vleck announce the removal of their electrical and general engineering offices to 100 Broadway, New York city. This is a particularly strong combination of electrical and mechanical engineering ability. Both of these gentlemen have been responsible for some of the most extensive and successful engineering of the present time.

MR. PAUL LUPKE, superintendent of the Trenton division of the Public Service Corporation of New Jersey, has been appointed editor of the question box for the twenty-ninth convention of the National Electric Light Association, which will be held next May or June. Mr. Lupke has been an enthusiastic admirer and student of the question box since its inception, and is a firm believer in its value to central stations.

MR. ANDREW CARNEGIE has made a gift of $100,000 to Union College, Schenectady, N. Y. The announcement was made at the annual dinner of the Union College Alumni Association. The General Electric Company has already presented to the college a building for the study of electrical engineering at Schenectady, at a cost of $25,000. This Mr. Carnegie has now promised to equip at an expense of $100,000, provided the college itself raises another $100,000 to endow it.

MR. GEORGE W. EDGE has joined forces with the American Electrical Novelty and Manufacturing Company, New York city, as assistant manager. Mr. Edge has been identified with the electrical field as a traveling salesman for some time, and for the past two years was with the Trumbull Electric Manufacturing Company, Plainville, Ct. Mr. Edge's training as a salesman has given him a valuable insight into the opportunity for desirable specialties, and his work in his present connection will, without doubt, be attended with material success.



MR. E. R. DAVENPORT.

MR. E. R. DAVENPORT has tendered his resignation as assistant secretary of the Edison Electric Illuminating Company, of Brooklyn, N. Y., and the Kings County Electric Light and Power Company, also of Brooklyn, to take effect January 1, 1906, when he will assume new duties as sales manager of the Narragansett Electric Lighting Company, Providence, R. I. Mr. Davenport has been connected with the Brooklyn lighting interests for the past ten years, having served during that time in various capacities. For some time he was private secretary to the late E. A. Leslie and to Mr. W. W. Freeman, vice-president of the companies. Mr. Davenport's new duties at Providence will offer a fine opportunity for the experience gained while in Brooklyn, as the Rhode Island properties are, like those of the Brooklyn corporation, guided by a progressive and enterprising management.

DR. HENRY S. PRITCHETT, for five years president of the Massachusetts Institute of Technology, has resigned. Mr. Pritchett will make his headquarters in New York as president of the Carnegie foundation fund for pensioning aged and needy professors. In his announcement of his resignation, Dr. Pritchett emphasizes his great regret at separating from the institute and its officers, and the faculty and students. The work has been enjoyable, and the most cordial relations have always existed. He also has a deep regret at leaving Boston and Massachusetts, for both of which he has formed the strongest ties. Dr. Pritchett has assured the corporation that he will remain at the head of the institute until a man has been chosen to succeed him.

ELECTRICAL SECURITIES.

After a session of decided activity and almost wild irregularity in price fluctuations, the market has come to a position of very great uncertainty. The outlook for monetary ease very materially strengthened the bull position, and the result was a series of manipulations that carried stocks to a point where many believe any really stable advance has been discounted. There are those in the financial community who now believe that this inflation is very dangerous in character, and that unless a very speedy return is made to a normal condition, the beginning of the new year will see a condition of distress rather than a continuance of the buoyancy which has existed. It can not be disputed that the backbone of the present boom is the unabated industrial activity which is reported from every section. It is fortunate that there is no sign of abatement in this direction. A point worthy of notice at this time is the very high price for raw copper. As the price goes up the discount is shortened, but, notwithstanding the high prices, the demand continues to be almost unprecedentedly large.

ELECTRICAL SECURITIES FOR THE WEEK ENDING DECEMBER 16.

New York:	*Closing.*
Brooklyn Rapid Transit	90⅛
Consolidated Gas	181
General Electric	175
Interborough Rapid Transit	217
Kings County Electric	200
Manhattan Elevated	163
Metropolitan Street Railway	120
New York & New Jersey Telephone	156
Westinghouse Manufacturing Company	190

The directors of the Western Union Telegraph Company have declared the regular quarterly dividend of 1¼ per cent, payable January 15 to stock of record December 20. The company's statement for the December 31 quarter (partly estimated) is as follows: net revenue, $1,900,000; bond interest, $331,300; balance, $1,568,700; dividends, $1,217,021, leaving a surplus of $351,679, which, added to the previous surplus, brings the total to $16,785,160.

The Interborough Rapid Transit Company is now carrying an average of 1,250,000 passengers daily. This compares with about 1,060,000 at this time last year.

Boston:	*Closing.*
American Telephone and Telegraph	136
Edison Electric Illuminating	245
Massachusetts Electric	59
New England Telephone	131
Western Telephone and Telegraph preferred	91

Philadelphia:	*Closing.*
Electric Company of America	11⅛
Electric Storage Battery common	82
Electric Storage Battery preferred	82
Philadelphia Electric	8½
Philadelphia Rapid Transit	31¼
United Gas Improvement	94½

United Gas Improvement directors have declared the regular quarterly dividend of 2 per cent, payable January 15 to stock of record December 30. It is estimated that the company's net earnings for 1905 will be not much below $5,000,000, which would be nearly 14 per cent on the $36,750,000 stock.

Chicago:	*Closing.*
Chicago Telephone	138
Chicago Edison Light	160
Metropolitan Elevated preferred	70
National Carbon common	76
National Carbon preferred	116
Union Traction common	10
Union Traction preferred	40

INDUSTRIAL ITEMS.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has issued bulletin No. 1047 from its electrical works, Cincinnati, Ohio, describing and illustrating Bullock oil-insulated transformers.

THE STANLEY-G. I. ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., in bulletin No. 20 describes watch-case instruments, both voltmeters and ammeters. Bulletin No. 42 describes and illustrates high-grade printing-press motors.

EUGENE DIETZGEN COMPANY, 119-121 West Twenty-third street, New York city, has just published a new book on the slide rule, by L. W. Rosenthal. This is a description of Mannheim and multiplex slide rules, giving the theory and practical application.

THE LOWE ELECTRIC COMPANY, 54 Vesey street, New York city, has opened its new store, where it is displaying a large and well-assorted domestic and imported stock of holiday goods, comprising electrical toys, mechanical toys, dolls, sleighs, tool-chests, Christmas-tree-lighting outfits, and other novelties.

THE GOHEEN MANUFACTURING COMPANY, Canton, Ohio, is distributing a series of large posters showing typical installations where the protective work has been done with the carbonizing coating and oxidized carbon cement made by the company. This material is put up in various forms for structural work.

PASS & SEYMOUR, INCORPORATED, Solvay, N. Y., is calling attention to its socket with the double pole by means of a neat mailing card. The company announces that the letters "P. & S." on all of its products indicate the firm name, and that they also appropriately describe the product, *viz.*, "perfection and satisfaction."

THE GERMANIA ELECTRIC LAMP COMPANY, Harrison, N. J., announces that it has been awarded a contract by W. H. Miller, deputy quartermaster general, U. S. A., to provide the government with 52,100 electric lamps. The lamps are to range in power from four to thirty-two candles, and in voltage from 100 to 250.

THE FEDERAL ELECTRIC COMPANY, Chicago, Ill., will be pleased to send some attractive literature dealing with the subject of the central-station load and electric signs. The company is the manufacturer of the Federal electric sign. These signs are of all-metal construction, the sign surface being of porcelain-enameled steel.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports that it has made some large shipments of cable to Bloomington, Ill. This company is stated to be doing a great deal of business in this line. In a recent booklet issued by the company regarding the material, it is announced that it has been found necessary to increase the capacity of the plant fourfold within two years.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Ct., is mailing an attractive folder calling attention to Trumbull flush receptacles. These receptacles fit all standard switchboxes, and take any Edison base attachment plug. They are quickly and easily installed, and are connected up from the front like a flush switch. The plate is countersunk to receive the ears that fasten the receptacle to the box. They are made regularly in nickel, polished brass and old brass, but any other finish can be furnished.

MR. C. R. UNDERHILL, electromagnet specialist, 55 Liberty street, New York city, has issued a new illustrated catalogue showing the various types of plunger-electromagnets, solenoids and other coils designed and supplied by him; and he has also revised and published a new edition of his booklet "Facts About Electromagnets." This booklet gives much information regarding electromagnets and solenoids, and contains authentic tables for magnet windings. Both the catalogue and booklet will be sent free to any address upon request.

THE B. F. STURTEVANT COMPANY, Boston, Mass., in bulletin No. 125 describes and illustrates class VS5 vertical engines. The company has equipped the St Denis boulevard car barns of the Montreal Street Railway Company with two complete heating plants and an induced draught apparatus for the boiler plant. The new machine and smithshops of the Pennsylvania Railroad Company at Hollidaysburg, Pa., are to be heated and ventilated by the Sturtevant company's apparatus. The fan is to be electrically driven by a Sturtevant motor.

THE RICHMOND ELECTRIC COMPANY, Richmond, Va., announces a new form of induction motor. The company has followed, to a considerable extent, European practice in the design of these machines. The bearings are made of aluminum bronze, and are split so that they can not stick to the shaft. The bearings are ring-oiled, and provided with large oil chambers with ample storage capacity. The shaft is extended on both ends so that, if desired, the motor can drive from either or both sides. The motors are built in standard sizes from one to twenty horse-power, for any phase, cycle and voltage.

THE BRILLIANT ELECTRIC COMPANY, 66 Chestnut street, Cleveland, Ohio, announces the appointment of Mr. E. J. Kulas as secretary and general manager. Mr. Kulas is well known in the incandescent lamp field, and in taking the management of the Brilliant Electric Company purposes manufacturing a new form of tipless lamp. Mr. Kulas announces that the company has a method of exhausting its tipless lamp which is fully covered by patents, and which enables it to make a very high-grade tipless bulb. Although the company will make a specialty of the manufacture of tipless lamps, it will also make a high-grade tipped lamp which will be guaranteed in every respect.

THE CONNECTICUT TELEPHONE AND ELECTRIC COMPANY, Meriden, Ct., has ready for distribution catalogues No. 9 and No. 10, describing long-distance and interior-telephone equipment, respectively. These catalogues are handsomely illustrated with half-tone engravings throughout, and careful detail is given to the description of each line of material. Each catalogue contains many new and up-to-date specialties. The company, during the last year, has been obliged to considerably increase its plant, and the prospects are bright for a larger business during 1906. The company was organized in 1893 to manufacture telephones and electrical specialties. Since that time it has grown each year to its present large capacity. The catalogues will be mailed to any one interested, upon request.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has closed a contract with the Spokane & Inland Railway Company, Spokane, Wash., for a storage battery outfit which will be installed to regulate the fluctuations of a single-phase railway load. Power is purchased as three-phase, sixty-cycle current from the Washington Water Power Company, on the minimum demand basis, and delivered through motor-generator sets to the single-phase line. Each motor-generator set will be provided with a direct-current machine mounted on the same shaft and connected to the terminals of the battery circuit. The battery, charge and discharge will be effected by putting boosters in the battery circuit, operating in parallel with each other, each having a capacity equal to one-half the maximum output of the battery. The boosters will be controlled by the Electric Storage Battery Company's carbon regulator, which in this case will be made responsive to the fluctuations of the alternating-current supply, causing the battery to keep these fluctuations within narrow limits.

NEW MANUFACTURING AND CONSTRUCTING COMPANIES.

SYRACUSE, N. Y.—The Syracuse Light and Equipment Company has been incorporated to deal in lighting apparatus. The capital is $100,000, and the incorporators are: William Darrone, C. E. Darrolm, both of Syracuse; A. A. Buck, New York.

JERSEY CITY, N. J.—The Jersey Electric Company has been incorporated to take over the business of Roach & Moller, manufacturers of telephones and of telephone appliances. The capital stock is $250,000, all common. The incorporators are: Frank W. Walton, Newark; Frank F. Groff and H. W. Hedenberg, New York.